A TREATISE
NAMED LVCARSOLACE
DEVIDED INTO FOVVER BOOKES,

which in part are collected out of diuerſe authors in diuerſe languages, and in part deuiſed by

CYPRIAN LVCAR Gentleman.

Syn.7.59.32

The contents of the ſaid fovver bookes are declared in the ſixt page.

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Diſpares mores diſparia ſtudia ſequuntur.

Tra ſepolto teſoro, & occulta ſapienza, non ſi conoſce alcuna differenza.

Imprinted at London by Richard Field for Iohn Harriſon, and are to be ſold at his ſhop in Paules church yard at the ſigne of the greyhound

1590.

79...656

102/15

TO THE RIGHT VVORSHIPFVLL HIS BROTHER IN LAVV MAISTER WILLIAM ROE ESQVIER, and Alderman of the honorable Citie of London.

SIR to doe good vnto my countrie, I haue with a willing minde compiled this treatise, and now to shew my selfe thankefull for your good affection towards me, I do with hand and hart dedicate the same vnto you. My worke penned with delight, and fraught with deuises which at times of leasure I doe vse for pastime to practise, is named LVCARSOLACE, wherein if I haue written amisse I am content you shall amend it, or if I haue written to litle, that you shall adde what wanteth, and with iudgement blame or prayse as shall seeme vnto you it hath deserued. Some of the able sort will set forth nothing in Print because (as they thinke) they cā not excell others if their knowledge gotten by studie should be made common to euery person, but I being persuaded that there is no difference betweene treasure buried vnder ground, and wisedome hidden in mans minde, doe put in Print my said LVCARSOLACE vnder your patronage, reuealing thereby my skill in diuers hidden verities which my coun-

re are borne ot onely for ur selues, but lso for our untrie, pa- ntes, and rendes.

trie may of duetie challenge, my friends by right doe merite, and my zeale to both these hath vrged me to publish. The phrase of my stile in this LVCARSOLACE is deuised rather to profite you and others my friendes and louing countriemen, than to please the eares of the eloquent Rethoritian or curious schooleman: for as a lofty and long discourse that will make of a molehill a mountaine, and of an Emmet an Elephant, is a thing irkesome vnto them which desire plainnesse and couet breuitie, so a plaine sense with truth and hartie affection vttered to friends is most allowable. But if any thing herein shall seeme hard to be learned, remember that vse maketh masterie, and that the best things can not without paines be gotten: which after they are obtained be in aduersitie a solace, in prosperitie an ornament, in youth commendable, in age delectable, and in all persons profitable. And considering my purpose in sending abroad this treatise is to profite Surueiors, Landmeaters, Landlords, Tenants, Buyers and Sellers of land, woods and trees, trauellers, gunners, men of warre, builders, and seamen, and also (if I may) to please euery man, and to offend no mã, you who haue alwayes been an earnest fauorer of good sciẽces, & a sincere friend to the professors of learning, with other wise and good men (as I hope) will iudge well of this my doing: and of those which shall iudge otherwise I thinke they are momes to be pardoned for their folly and pittied for their ignorance, a witch and monster that neuer knew vertue, good manners, or dutie, nor meaneth truth howsoeuer she flatters. I would here earnestly desire you to be patron of my LVCARSOLACE, but I thinke it

omus was ŏg the hea- n a God of rehension, d of him all rious repre- ndours are lled in La- Momi, and Englishe omes.

not

not neceſſarie: for as ſpurres vnto thoſe which can not be ſtopped with bridles are needleſſe, ſo intreaties to you who are thereunto perſwaded, and haue already granted my deſire therein, will be ſuperfluous: wherefore vowing vnto you my good will for euer, I leaue at this preſent to trouble you with more words, and committing you to the tuition of the omnipotēt God, whom you ſerue, and whoſe you are, I pray him to grant vnto you and your offpring, long and proſperous felicitie in earth, and perpetuall conſolation in heauen. From my houſe in London the 1. day of May in the yeare of the creation of the world. 5552, and in the yeare of our redemption. 1590.

Your louing brother in law
CYPRIAN LVCAR.

The Contents of the foure Bookes of Lvcar solace.

THe firſt booke containeth definitions of diuers words and termes, names and lengthes of diuerſe Engliſh meaſures, a true difference betweene an acar of land meaſured with a pearch of 12. foote, 18. foote, 20. foote, or 24. foote in length, & an acar of land meaſured with a pearch of 16. foote & a halfe foote in length, names and tipes of diuerſe geometrical inſtruments, names and dwelling places of workemen which can make and do ſell ſuch inſtruments, meanes to deſcerne whether or no the edge of a ruler is right, and infallible inſtructions, by which an ingenious Reader may eaſily meaſure vpon any ſmooth table, drummes head, ſtoole or other ſuperficies, meaſurable lengthes, bredthes, heights and depthes, applie knowne lengthes bredthes, heightes and depthes to many good purpoſes, know recorded heights, lengthes and bredthes of ſome famous monuments in Sarum, in Weſtminſter, and in the honorable Citie of London, know the antiquitie of the ſayd City of London, draw the true plat of any place, make a fit ſcale for any plat or mappe, reduce many plats into one faire mappe, reduce a mappe from a bigge forme to a leſſe forme, and from a leſſe forme to a bigge forme, and learne to note the commodities and diſcommodities of places.

The ſecond booke ſheweth how an ingenious perſon may meaſure a rightlined diſtance betweene any two places deſcribed in a mappe, how he may meaſure the circuite and ſuperficiall content of any deſcribed peece of land, how he may finde the center of any polygonon equiangle figure, how he may finde the center of any circle, how he may make by a part of a circumference, the whole circumference agreeing vnto that part, how he may bring any rightlined figure into triangles, and how he may know what number of angles in a rightlined figure are equall to any certaine number of right angles.

The third booke inſtructeth the reader to make any triangle, ſquare, or long ſquare, to erect a plumbe line vpon any part or point of a line, to diuide any circle into diuers numbers of equall parts, to make any polygonon equiangle figure, to make an egge forme figure, to know when a figure is inſcribed within another figure, or circumſcribed about an other figure, to inſcribe certaine rightlined figures within certaine other rightlined figures, to circumſcribe certaine rightlined figures about certaine other rightlined figures, to deuide a right line into ſo many equall parts as he will, to tell whether a thing ſeen far off doth ſtand ſtill, goe from him, or come towardes him. To draw a right line equall to any aſſigned archline, or to the whole circumference of any aſſigned circle, or to any aſſigned part of a circle, to draw a circular line equall to any aſſigned rightline, to ſeparate, lay out, & incloſe within a long ſquare one, two, or three acars of land, by diuers waies, from any peece of ground adioyning, to change a figure of one forme into an equal figure of another appointed forme, to make a rightline angle equall to a rightline angle giuen, to drawe a parallel line to a right line giuen, and to cube any aſſigned Sphere.

The fourth booke teacheth the reader to know fruitfull, barren, and minerall grounds, growthes, ages, and ſolide contents of trees, and where a good aire is, it doth alſo teach the reader to build for the preſeruation of health, to make a tunnell of a chimney, ſo as no ſmoke ſhall annoy him in his houſe, to fell timber and make ſound boords for buildings, to ſinke a well in due time, and in a place where water may be found, and to know whether a new found ſpring of water will drie vp in an hot and drie ſummer. Alſo it ſheweth how water in a ſhallow well is more wholeſome than water in a deepe well. How euerie well ought to be vncouered and oftentimes drawne drie, how the vſe of water is neceſſarie, how diuers ſorts of water haue diuers qualities, how there are diuers meanes to trie among many ſorts of water which water is beſt, how great ſtore of water may be throwne out of a new deuiſed ſquerte vpon any fired houſe or other thing, how the right leuell of any peece of ground may be found, how any water leuell may be found, how water may be brought in pipes or in gutters within the ground vnto any appointed Seſſerne, how the depth of any ſea may be found, how the force of running waters which weare away land may bee broken, how wet grounds and bogges may be drained, & how by the arte taught in theſe foure bookes the ingenious Reader may deuiſe new works, ſtrange anguins and inſtruments not onely for priuate pleaſure, but alſo for ſundry purpoſes in the common wealth.

IN THE NAME OF GOD AMEN.

THE FIRST BOOKE OF LVCARSOLACE, CONTAINING DEFINITIONS OF DIVERS WORDS AND TERMES, NAMES

and lengthes of diuerſe Engliſh meaſures, a true difference betweene an acar of land meaſured with a pearch of 12. foote, 18. foote, 20. foote, or 24. foote in length: and an acar of land meaſured with a pearch of 16. foote and ½ foote in length. Names & tipes of diuers Geometrical inſtruments: Names and dwelling places of workmen which can make and do ſell ſuch inſtruments: Meanes to deſcerne whether or no the edge of a ruler be right; and infallible inſtructions by which an ingenious reader may eaſily meaſure vpon any ſmooth table, drums head, ſtoole, or other ſuperficies, meaſurable lengthes, bredthes, heightes, and depthes apply knowne lengthes, bredthes, heigths, and depthes to many good purpoſes, know recorded heigthes, lengthes, & bredthes of ſome famous monuments in Sarum, in Weſtminſter, and in the honorable cittie of London: know the antiquitie of the ſaid citie of Lõdon: draw the true plat of any place, make a fit ſcale for any plat or mappe, reduce many plats into one faire mappe, reduce a map from a bigge forme to a leſſe forme, & from a leſſe forme to a bigge forme, and learne to note the commodities and diſcommodities of places, in part collected and tranſlated out of diuerſe authors in diuerſe languages, and in the greateſt part deuiſed by CYPRIAN LVCAR GENTLEMAN.

CHAP. I.

Definitions collected out of Euclide and other Authors of diuerſe words and termes recited in this Treatiſe.

A PRICKE, ſigne, or point, is that which hath no part, as is this pricke, ſigne, or point marked vnder A. 1

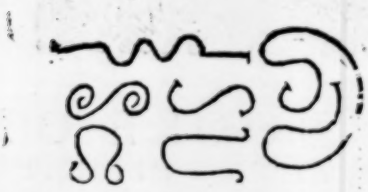
A line is length without bredth, as is this line, A——B 2

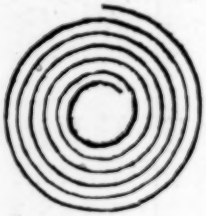
The ends or limits of a line are points, as the points A B are the ends of this line A——B 3

A right line is that which lieth equally betweene his points, as the whole line AB lieth ſtraight & equally betweene the points A——B without any going vp or comming downe on either ſide. 4

All lines which go not right forth from point to point, but bow any way, 5

are crooked lines, and though of them there are innumerable diuerſities, I haue for examples ſet here ſome crooked lines of diuers faſhions.

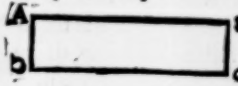




6 A ſuperficies is that which hath onely length and bredth.

7 Extreames of a ſuperficies are lines.

8 A plaine ſuperficies is that which lieth equally betweene his lines, as this ſuperficies lieth equally and ſmooth betweene the two lines A C and B D, or betweene the two lines A B and C D, ſo that no part thereof either ſwelleth vpwards, or is depreſſed downwards.



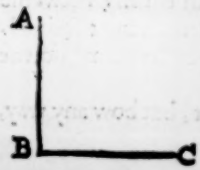
9 A plaine angle is an inclination or bowing of two lines the one to the other, and the one touching the other, and not being directly ioyned togither, as do the two lines A B and B C.

10 If the lines which containe the angle be right lines, then it is called a right angle; as is the angle A B C in the former figure: where note that an angle is for the moſt part deſcribed by three letters, of which the ſecond or middle letter repreſenteth the verie angle, and therefore is ſet at the angle.

Note.

11 When a right line ſtanding vpon a right line maketh the angles on either ſide equall, then either of thoſe angles is a right angle, and the right line which ſtandeth erected is called a perpendicular or plumbe line to that vpon which it ſtandeth.

12 A ſquier line is that which cutteth or toucheth any line or thing ſquierwiſe, as in the figure belonging to the leuenth definition, the line A B is a ſquire line, becauſe it cutteth the line C D ſquierwiſe: and in the figure belonging to this twelft definition, the line A B is a ſquire line, becauſe it toucheth the line C B ſquirewiſe: and the line C B is alſo a ſquier line becauſe it toucheth the line B A ſquierwiſe.



A limite

This table is to be placed opposite to the page marked with folio 10.

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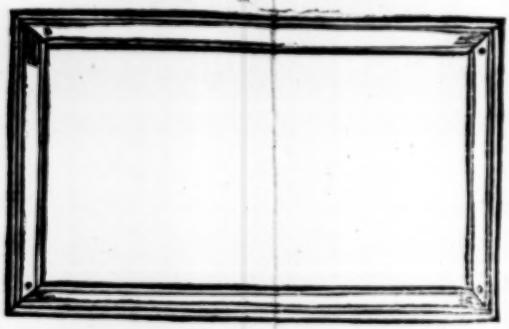
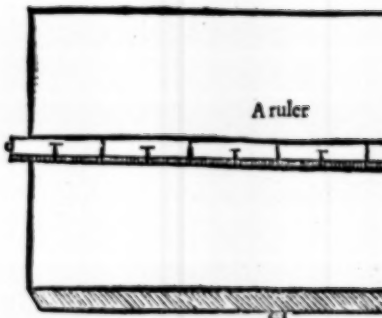
The frame that holdeth fast downe the paper which couereth the geometricall table.



A geometricall table



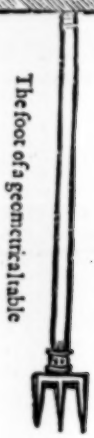
A ruler

A drumme

A keeler or penfill

A ſharpe pointed cole

The foot of a geometrical table



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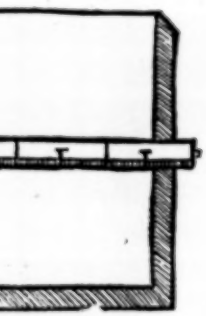
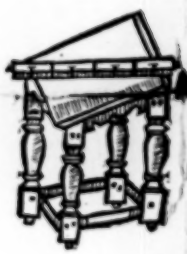
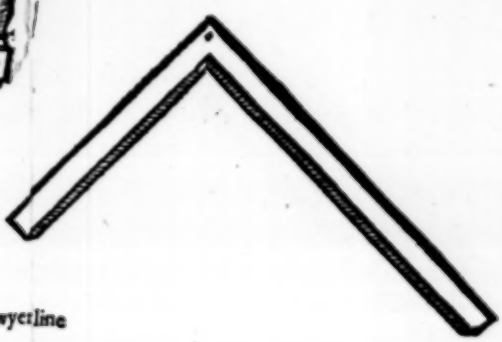


A compaſſe

A ſtoole



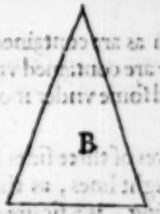
A Squire



A wyerline

A limite or terme is the end of euerie thing. 13

A figure is that which is contained vnder one limite or terme, or manie, as 14
in the examples following the figure A is contained vnder one limit or terme, which is the round line. Also the figure B is contained vnder three lines, and the figure C is contained vnder foure lines, and so of others which are their limits or termes.

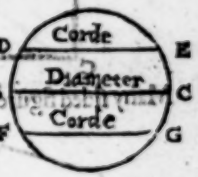


A circle is a plaine figure contained vnder one line, which is called circum- 15
ference, as is the circle A in the former example.

The point set in the middest of a circle (as is the point A in the former cir- 16
cle) is called the center of the circle.

A diameter of a circle is a right line, which drawne 17
by the center therof, and ending at the circumference on either side, deuideth the circle into two equal parts, as the line B A C is the diameter of this circle.

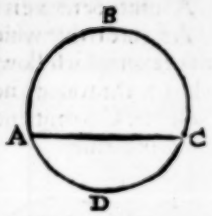
All straight lines besides the diameter in any circle 18
pulled from one part of the circumferece to the other, are called cords: as for example in this circle folowing the lines D E F G are cords.



A semicircle is a figure which is contained vnder the diameter, and vnder 19
that part of the circumference which is cut off by the diameter, as in A B C D the circle following the figure A B C is a semicircle, because it is contained of the right line B G C which is the diameter, and of the arke or arch line A B C, being that part of the circumference which is cut off by the diameter B G C. So likewise the other part of the circle, namely B D C is a semicircle.

A section or portion of a circle is a figure which is contained vnder a right 20

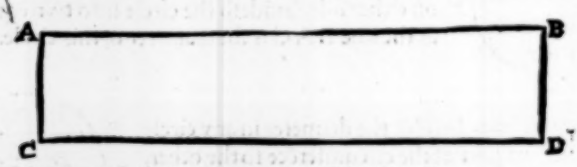
line and a part of the circumference, greater or leſſe than the ſemicircle, as A B C in the circle following is a portion of that circle though it be greater than halfe the circle. And likewiſe A D C is a portion of that circle, though it be leſſe then the halfe circle.



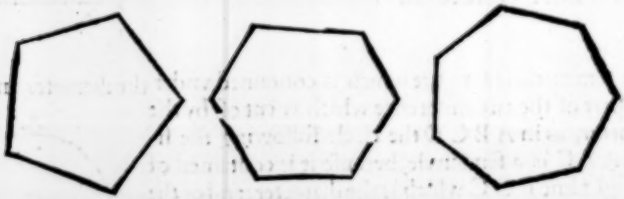
21 Rightlined figures are ſuch as are contained vnder right lines: and of them ſome are contained vnder three right lines, ſome vnder foure, ſome vnder fiue, and ſome vnder mo.

22 Three ſided figures or figures of three ſides are ſuch as are contained vnder three right lines, as the figure A B C in the example following, is a figure of three ſides, becauſe it is contained vnder three right lines, namely, vnder the lines A B, B C, C A.

23 Foure ſided figures, or figures of foure ſides, are ſuch as are contained vnder foure right lines, as the figure here ſet is a figure of foure ſides, for that it is comprehended vnder foure right lines: namely A B, B D, D C, C A.



24 Many ſided figures are ſuch as haue mo ſides than foure.

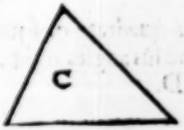


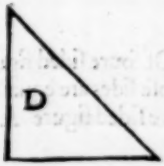
Note. Here note ye, that euerie right lined figure hath as many angles as it hath ſides, and taketh his denomination as well of the number of his angles, as of the number of his ſides. As a figure contained vnder three right lines of the number of his three ſides is called a three ſided figure, ſo of the number of his three angles it is called a triangle. Likewiſe a figure contained vnder foure right

right lines, by reaſon of the number of his ſides is called a foureſided figure, and by reaſon of the number of his angles, it is called a quadrangled figure, & ſo of others.

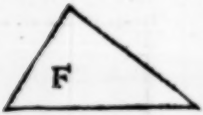
Of three ſided figures or triangles, an equilater triangle is that which hath three equall ſides, as is the triangle A in this example. 25

Iſoſceles is a triangle which hath onely two ſides equall, as are the triangles B, C and D in theſe examples. 26

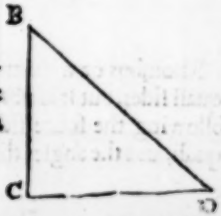


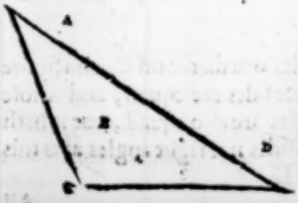


Scalenum is a triangle, whoſe three ſides are all vnequall, as are the triangles E F in theſe examples. 27



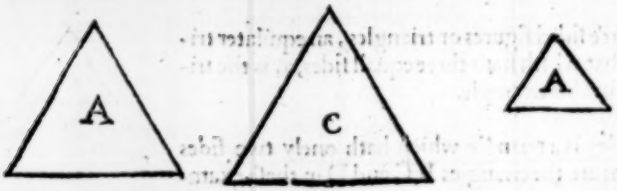
Againe of triangles an Orthigonium or a right angled triangle, is a triangle which hath a right angle: as the triangle B C D, of which the angle B C D is a right angle. 28

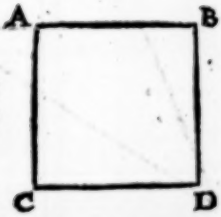




An Ambligonium, or an obtuſe angled triangle, is a triangle which hath an obtuſe angle, as is the triangle B, whoſe angle A C D is an obtuſe angle. 29

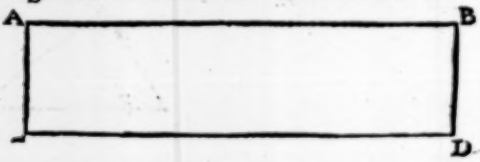
30 An Oxigonium or an acute angled triangle, is a triangle which hath all his three angles acute, as are these triangles A C A.





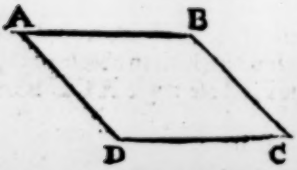
31 Of foure sided figures a quadrate or square is that whose sides are equall, and his angles right, as is this foure sided figure, A B C D.

32 A figure on the one side longer, or square-like, or as some call it a long square, is that which hath right angles and not equall sides: as for example in the figure following the angles are right angles, and the two sides therof A B, and C D, are longer than the other two sides A C and B D.



33 Rhombus or a diamond, is a figure hauing foure equall sides, but it is not right angled: as in this figure following the foure sides A B, B C, C D, D A, be equall, and the angles thereof are not right angles.

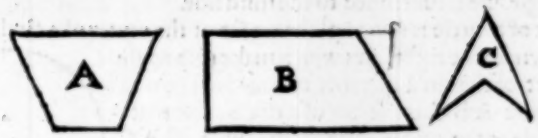
34



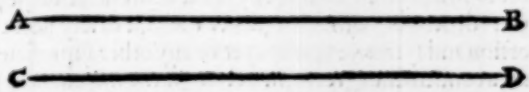
Rhomboides or a diamond like, is a figure whose opposite sides are equall, and whose opposite angles are also equall, but it hath neither equal sides nor right angles, as is this figure A B C D.

All

All other figures of foure ſides beſides theſe, are called Trapezia, tables, or irregular figures, as are the figures A B C. 35



Paralell or equidiſtant right lines are ſuch which being in one and the ſelfe ſame ſuperficies, and produced infinitely on both ſides, do neuer in any part concurre or meete, as are the lines A B and C D in this example. 36



The horizon is a circle which deuideth and parteth that part of the world which we ſee, from that which doth not appeare: & which parteth the world in two equall parts, in ſuch faſhion, as the one halfe is euer aboue the earth, the other alwayes vnder. 37

An horizontall diſtance is a diſtance lying in a leuell or paralell line to the horizon. 38

An hipothenuſall diſtance, or (which is all one) a diametrall diſtance, is a linearie length higher at one end then at the other, and of ſome is called a ſlope diſtance. 39

The Area of a figure, is that ſpace which is contained within the ſides of the figure: as for example, the area of this figure next following, is the ſpace betweene A B, B D, D C, and C A, the fower ſides thereof. 40

The circuite or compaſſe of a figure, is a line compoſed of all the ſides thereof. 41

One ſide of a plaine figure is equall to another, and ſo generally one right line is equall to another, when the one being applied to the other, their extremes agree together. 42

A parallelogramme is a figure of fower ſides, whoſe two oppoſite or contrarie ſides are equall the one to the other, and of parallelogrammes there are fower kinds: that is to ſay, a ſquare, a figure of one ſide longer, a Rhombus or diamond, and a Rhomboides or diamond like figure: and of theſe fower ſorts, the ſquare, and the figure of one ſide longer, are onely right angled Parallelogrammes for that all their angles are right angles. 43

44 That angle is said to subtend a side of a triangle, which is placed directly opposite and against that side, and that side is said to subtend an angle which is opposite to the angle: for euery angle of a triangle is contained of two sides of the triangle, and is subtended to the third side.

45 A sector of a circle is (an angle being set at the center of a circle) a figure contained vnder the right lines which make that angle, and the part of the circumference receaued of them: as here the figure A B C is a sector of a circle, for that it hath an angle at the center, namely the angle, B A C, and is contained of the two right lines A B and A C, which containe that angle, and the circumference receaued by them.

46 A scale is a measure deuided into many equall parts, made at the will of the measurer great or litle, and to be named by what denomination he pleaseth, to set forth heights, depths, breadthes, lengths, & the plat of any peece of ground in true proportion and symetrie vpon paper or any other superficies.

47 Symetrie is a conuenient agreement betweene the members or parts of any thing aunswering in euery part separate vnto the proportion of the whole figure.

48 A poligonon figure is a figure consisting of many sides.

CHAP. II.

The names and lengthes of diuers English measures, and a true difference betweene an acar of land measured with a pearch of 12. foote, 18. foote, 20. foote, or 24. foote in length, and an acar of land measured with a pearch of 16. foote and ½. foote in length.

THree barley cornes drie and round do make an inch of assise, 12. inches of assise make a foot of assise, one foot & a half foot of assise make a cubite, 3. feete of assise or 2. cubits make a meating yard, 2. meating yards make a fadome, 5. meating yards and ½. meating yeard make a statute pearch; one statute pearch in breadth, and 4. statute pearches in length make a day worke, 10. day workes make a rood, or (as some name it) a farthendele, or (which is all one) a quarter of an acar, one statute pearch in bredth, & 160. statute pearches in length make an acar, which doth containe 6272640. square inches. 4. acars (as *Fabian* in his chronicle and historie of king *William* Conquerer hath written) make a yard of land, 5. yards of land make a hide of land, and 8. hides of land make a Knights fee, which (as the said *Fabian* hath also written) is a plough till a yeare. Moreouer note that 16. english elles in length make 20. meating yards in length, 20. meating yards in length make a score, 40. statute pearches in length an English furlong, 8. English furlongs in length an English mile, and that the number of inches of assise

statute acar and doth cō- 6272640 are inches ich do make 160. square e, or 4840. re yardes, 60. square rches.

aſſiſe, feete of aſſiſe, cubites, meating yardes, engliſh elles, fadomes, ſtatute pearches, and ſcores which are in an engliſh mile, doth here followe.

63360. inches of aſſiſe
5280. feete of aſſiſe
3520. cubites
1760. meating yards } in length make an Engliſh mile.
1408. Engliſh elles
880. fadomes
320. ſtatute pearches
88. ſcore

I haue in this chapter made mention of engliſh miles and ſtatute pearches, becauſe the Italian mile containing in length 5000. feete, differeth from our engliſh mile comprehending in it 5280. feete, and becauſe our ſtatute pearch which is ordained by a ſtatute made in the 33. yeare of king Edward the firſt, varieth from a pearch of 12. foote in length, called by ſome tenantright, and by others curtmeaſure, wherewith medow grounds in diuerſe places of England are meaſured to the intollerable loſſes of buyers, and for that our ſaid ſtatute pearch hath no equalitie with a pearch of 18. foote in length, called of ſome a woodland pearch, or with a pearch of 20. foot in lēgth, or with a pearch of 24. foot in length, which are alſo vſed in many places of this realme by meaſurers of wood lands to the manifold diſaduantages of ſellers. For whoſoeuer will compare the ſaid vnequall pearches one with the other, ſhall find that acars of land meaſured with the ſaid vnequall pearches do thus differ.

Two roods of a ſtatute acar, one day worke of a ſtatute acar, and $\frac{72}{121}$. of a ſtatute pearch, do containe one acar meaſured with a pearch of 12. foot in lēgth.

One acar meaſured with a pearch of 18. foote in length, doth containe one ſtatute acar, ſeuen dayworks of a ſtatute acar, two ſtatute perches, and $\frac{17}{121}$. of a ſtatute pearch.

One acar meaſured with a pearch of 20. foote in length doth containe one ſtatute acar, one roode of a ſtatute acar, three ſtatute pearches and $\frac{81}{121}$. of a ſtatute pearch,

One acar meaſured with a pearch of 24. foote in length, doth containe two ſtatute acars, foure dayworks of a ſtatute acar, two ſtatute pearches, and $\frac{41}{121}$. of a ſtatute pearch.

CHAP. III.

The inſtruments which are needfull for them that will practiſe ſuch things as are taught in this booke, the names and dwelling places of workemen which do make and ſell ſuch inſtruments, and the meanes by which any perſon may deſcerne whether or no the edge of a Ruler is right.

TO meaſure lengthes, bredthes, heights, and depthes, and to draw the plat of a field, fort, campe, towne, cittie, lordſhip, ſhiers, or countries by the

art taught in this booke, you ſhall prepare a geometricall table with all ſuch neceſſarie things as appertaine to it. That is to ſay, a ſtaffe or foote to beare the ſaid table, a frame to hold faſt downe the paper which ſhall couer the ſame table, a ruler, a compaſſe, a ſquare, a fine pointed cole or keeler, and a wyer line of two, three or foure pearches in length, which ought to ſhew apart euery pearch halfe pearch, quarter pearch, and foote contained in it.

In ſteed of a geometricall table you may vſe if you pleaſe for any menſuration or plat a drumme, ſtoole, or any other ſuperficies: ſo as in thoſe workes where I do teach you to ſet the flat of the table leuell and pararell to the horizon, you will in like maner lay the flat of the drummes head, ſtoole or other ſuperficies leuell and paralell to the horizon, and will when you worke hang the flat of the drummes head, ſtoole, or other ſuperficies in a perpendicular height ouer the horizon where I do teach you to place the geometricall table vpright vpon one of his ſides, ends, or edges: for by what rule and reaſon the worke is done vppon a geometricall table, by that rule and reaſon the ſame worke may be done vpon a drummes head, ſtoole, or any other ſuperficies.

Geometricall tables with their feete, frames, rulers, compaſſes, and ſquires are made and ſold by *Iohn Reynolds*, dwelling right againſt the ſoutheaſt end of Barking churchyard in tower ſtreete within London, and by *Iohn Reade*, and *Chriſtopher Paine*, dwelling in Hoſier lane neere vnto Weſt ſmithfield in the ſuburbs of London: wyer lines like to that aboue menſioned, may be bought in crooked lane neare vnto Eaſtcheape in London, and you may buy of any painter for a penny 3. or 4. fine pointed coles or keelers: but for your better inſtructions, the tipe of euery one of the ſaid inſtrumẽts is to be viewed in the ſide of paper oppoſite to this page.

Although you may ſet vpon euerie of the ſaid rulers two clipping ſightes perpendicularly reared, yet I thinke it better in the places of the ſaid ſights to make in euerie of the ſaid rulers from one of their ends to the other, a right, narrow and ſhallow grooue or channell couered ouer with a thinne peece of wood, ſo as you may looke thorow it at any marke within a conuenient diſtance. And conſidering that you ſhal oftentimes haue occaſion to draw right lines by the edge of your ruler, it is requiſite that the edge of your ruler ſhould alwayes be right, and that you ſhould be ſkilfull to deſcerne whether a ſuſpected edge be ſo or no, which is a thing eaſie to be learned by theſe precepts following. Lay your ruler vpon a ſmooth borde or ſome other ſuperficies, make at ech end of the edge of your ruler a verie ſmall point, and then draw with a light hand by that edge a fine ſmall line from one of thoſe points to the other: this done, turne contrariwiſe the ſaid edge vpon the ſaid ſmall line, that is to ſay, put that end of the edge which before touched the point towards your right ſide, to the point towards your left ſide, and the other end of the edge which before was ioyned to the point on your left ſide, to the point on your right ſide, and draw as you did before with a light hand by the ſaid edge of the

theruler,another fine line from one of the ſaid points to the other: after this taking vp your ruler, looke aduiſedly whether the ſecond line doth lie iuſtly vpon the firſt line and is one line with it, for if both of them make one line, you may affirme that the ſaid edge of your ruler is right and fiduciall, but if a ſpace be betweene the firſt and ſecond line, then the ſecond line lieth not iuſt ouer the firſt line, and thereupon you may ſay that the ſame edge of your ruler is crooked, & that the two lines drawne by it are crooked, becauſe two right lines by the laſt petition of the firſt booke of *Euclide* can neuer include a ſpace or ſuperficies.

A right and fiduciall edge of a ruler.

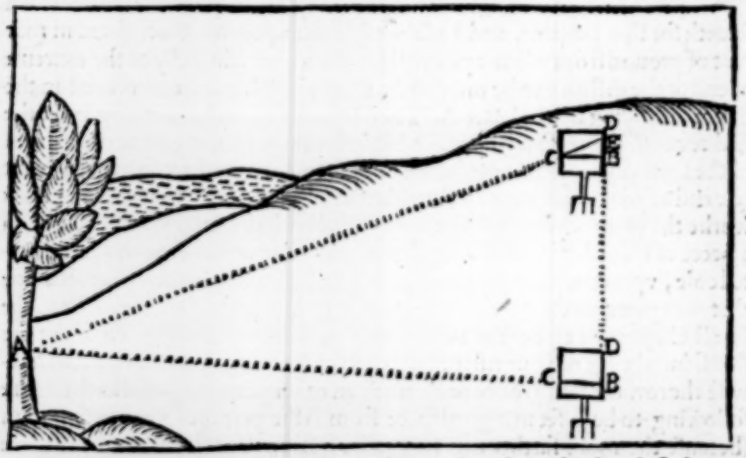
CHAP. IIII.

How you being vpon a low ground, may meaſure at two ſtations without Arithmeticall calculation, any horizontall or hipothenuſall diſtance.

TO meaſure without Arithmeticall calculation how far a tower, houſe, tree, or any other thing ſeene in an horizõtall or hipothenuſall diſtance is from you, couer your geometricall table with a cleene white ſheete of paper, and hauing made the paper to lie ſmooth and faſt vpon the table by the helpe of the frame which ſerueth for that purpoſe, and laid the table flat vpon his foote fixed in that part of ground from whence you will meaſure, note aduiſedly in the extreme or end of the diſtance to be meaſured, a little viſible marke expreſſed in the figure following by the letter A. Then laying your ruler flatlong vpon the ſaid couer of paper, ſo as you may plainly ſee through the grooue or channell of the ſame ruler, A the noted marke, make a fine pricke vpon the paper at one end of your ruler hard by the fiduciall edge thereof, to repreſent in this worke the place of your firſt ſtation marked with the letter B, and draw with a peece of black lead (called amõg painters a keeler) or rather with a fine pointed cole, vpon the paper by the ſame fiduciall edge of your ruler, a right line that may point directly from the pricke B to A the noted marke, as doth the line B C vpon the tipe of the table in the figure following. This done put the ſaid fiducial edge of your ruler to the ſaid pricke B ſo as you may behold ſidewiſe thorow the ſaid grooue or channell an other place ſuppoſed in the figure following to be E ſet in a good ſpace from B the pricke of your firſt ſtation (becauſe the more farther this ſidemarke is from your firſt ſtation the more better it is for your purpoſe) and then draw a ſquire line by the ſaid fiduciall edge with a keeler or cole that may point directly from B to E the eſpied ſide marke, as doth the line B D in the figure following. After this take vp your Geometricall table, and leauing an arrow or ſticke ſet vpright in the point of grounde directly vnder B the pricke of your firſt ſtation, erect three or foure other arrowes, or ſticks in a right line betweene the arrow or ſticke in the ſaid point of ground vnder B, and the ſide marke E, and meaſure exactly with a

A ſharpe pointed peece of blacke lead is called among Painters a keeler.

wier line how many yardes are betweene the ſaid arrow or ſticke vnder B, and the ſide marke E, and keeping in your remembrance the ſaid meaſure of yards ſet your table faſt and flat vpon his foote at E in euerie reſpect as it ſtood before at your firſt ſtation, and by ſo doing you ſhall ſee that the ſaid line D B wil poinct directly from E the place of your ſecond ſtation, to the arrow at your firſt ſtation, and that the ſaid pricke B will lie directly in a right line betweene D and the ſaid arrow or ſticke erected at your firſt ſtation. When all this is done, open your compaſſe to ſo many equal parts in the meaſure of your ſcale, as there are yards in the diſtance betweene the arrow ſet vp at your fiſt ſtation, and the foote of your ſaid table at your ſecond ſtation, and then ſetting one foote of your compaſſe vnaltred vpon the ſaid pricke B, make with the other foote of your compaſſe a ſecond pricke in the line B D which in the figure following is E, and after that laying the fiduciall edge at one end of your ruler to the ſaid ſecond prick, that is to ſay, to the pricke E, and making it there to tarry, moue the other end of the ruler to or fro, till you may behold thorow the ſaid grooue or chanell from the ſecond pricke E, the ſaid A at the extreme or end of the diſtance to be meaſured: which done, draw with a keeler or cole by the ſaid fiduciall edge a right line that may point directly from E the ſe-



cond pricke, vnto the ſaid A, and note diligently where this line laſt drawne cutteth the line B C, for now by opening againe the feete of your compaſſe to the ſpace betweene the ſaid interſection and the pricke B, and applying them in that meaſure or wideneſſe to the equall diuiſions of your ſcale, you may affirme that there are ſo many yardes in the diſtance betweene the arrow ſet vp at your firſt ſtation, and A the noted marke, as there are diuiſions of your ſcale betweene the two feete of your compaſſe. In like manner by ope-

ning

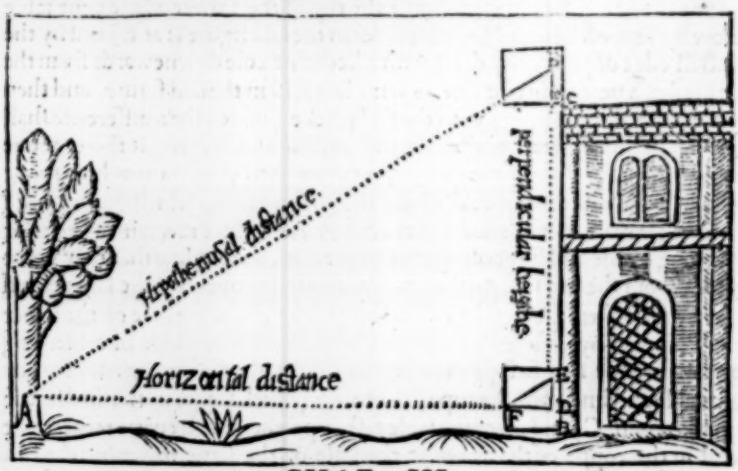
ning your compaſſe to the ſpace betweene the ſaid interſection and the pricke E, & applying them in that meaſure or widenes to the equal diuiſions of your ſcale, you may know how many yards are in the diſtance betweene your ſecond ſtation and A the noted marke.

CHAP. V.

How you being vpon a Tower, or any other height, may meaſure from the top and baſe of the ſame Tower, or other height, without arithmeticall calculation any horizontall or hipothennuſall diſtance.

AFTER you haue couered your table with a cleane white ſheete of paper, and made the paper to lye ſmooth, and faſt vpon the table by the helpe of the frame which ſerueth for that purpoſe, ſet the table faſt, and vpright vpon one end in the top of an height (which here by ſuppoſell ſhall be a Tower) ſo as laying your ruler cloſe vnto the paper, and mouing it vp or downe cloſe by the ſaid paper, you may behold thorow the grooue or channell of your ruler, the baſe of the ſaid Tower (marked in the figure following with B) and alſo the extreame or end of the diſtance to be meaſured, marked in the ſaid figure with A. This done make a fine prick in the vppermoſt part of the ſaid paper to repreſent in your worke the top of the Tower where your table is now by ſuppoſell placed (which pricke in the ſaid figure is at E) and by the fiduciall edge of your ruler draw with a keeler or cole downewards from the ſaid pricke, a perpendicular line, as is the line E D in the ſaid figure, and then lay the ſame fiduciall edge vnto the ſaid pricke (which for a difference ſhall hereafter in this chapter be called the firſt pricke) and keeping it there, moue the ruler to or fro cloſe by the ſaid paper, til you ſhall eſpie thorow his grooue or chanell the extreme or end of the deſired diſtance, which (as before I haue ſaid) is marked in the ſaid figure with A. After this draw with a keeler or cole along by the ſaid fiduciall edge of your ruler, a right line that may point directly from the ſaid firſt pricke, vnto the extreme or end of the ſaid deſired diſtance: and then the height of the firſt pricke aboue the baſe of the tower being knowne by your inſtrument or the length of your wier line hanging downe from the ſaid firſt pricke vnto the baſe of the ſaid tower, take away your table and line from the top of the tower (which toppe in the ſaid figure is marked with C) and place the table faſt, vpright, and in euerie reſpect as it ſtood in the toppe of the tower at the baſe of the ſame tower marked in the ſaid figure with B, directly vnder that part of the toppe where it ſtood before, and opening your compaſſe in the meaſure of your ſcale to ſo many equall parts as there are feete in the height of the ſaid pricke aboue the ſaid baſe, fixe one foote of the ſame compaſſe vnaltered in the ſaid pricke marked in the ſaid figure with E, and with the other foote of the compaſſe make a ſecond pricke in the ſaid perpendicular line, which ſecond prick in the ſaid figure is marked with D, and repreſenteth the baſe of the ſaid Tower.

When you haue done all this, and haue laid the fiduciall edge of your ruler to the ſame ſeconde pricke, and haue eſpied againe thorowe the ſaid channell or groouе by turning your ruler about vpon that ſeconde pricke, the extreame or end of the diſtance to be meaſured, draw with a keeler or cole a right line by the fiduciall edge of your ruler that may point from the ſaid ſecond pricke to the extreame of the diſtance to be meaſured, and note where this line laſt drawne cutteth the other line which pointed from the firſt pricke to the extreame of the diſtance to be meaſured: for now by opening againe the feete of your compaſſe to the ſpace betwene the ſaid interſectiō marked in the ſaid figure with F, and the ſaid ſeconde pricke marked in the ſaid figure with D, and applying them in that meaſure or wideneſſe, to the diuiſions of your ſcale, you may affirme that there are ſo many feete in A B the horizontall diſtance thus meaſured, as there are diuiſions of your ſcale betweene the two feete of your compaſſe. In like manner by opening the feete of your compaſſe to the ſpace betweene the ſaid interſection, and the firſt pricke, marked in the ſaid figure with E, and applying them in that meaſure or wideneſſe to the diuiſions of your ſcale, you may know how many feete are in the hipothenuſall diſtance marked in the ſaid figure with A E.

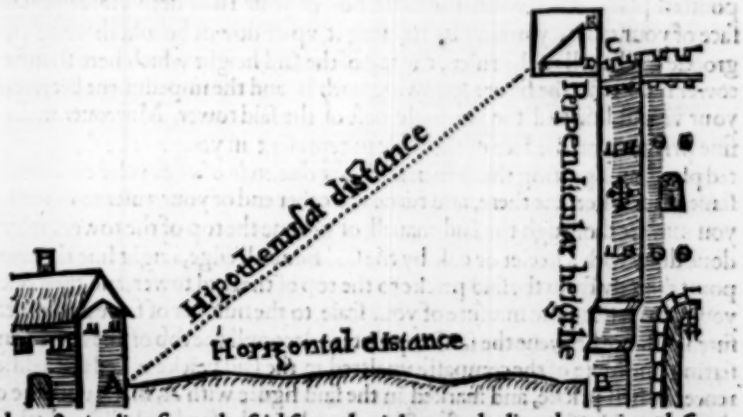


CHAP. VI.

How you being vpon the toppe of a tower, or any other height, may meaſure at one ſtation without Arithmetical calculation, an horizontall diſtance lying in a plaine ground at the baſe of the ſame Tower or height, and alſo an hipothenuſall diſtance.

COuer your table with paper laid faſt & ſmooth vpon it as you haue bene taught before to do, and ſet the table faſt and vpright vpon one end in the toppe

top of a tower, or another height, ſo as after the flat ſide of your ruler is layde cloſe vnto the ſayd paper, you may by mouing it vp or downe behold thorough the grooue or chanell of the ſame ruler the baſe of the ſayd tower or height marked in the figure following with B, and alſo the extreme or end of the diſtance to be meaſured marked in the ſaid figure with A. Moreouer make a fine prick in the vppermoſt part of the ſaid paper to repreſent in your work the top of the ſayd height (which ſhall here be a tower marked in the figure following with C) where your table by ſuppoſall is now placed, which pricke in the ſayd figure is E: & by the fiduciall edge of your ruler draw downwards from the ſaid pricke, a perpendicular line as is the line E D in the ſaid figure. Alſo meaſure with your wyer line hanging downe from the ſaid pricke vnto the baſe of the tower, the height of that pricke aboue the ſaid baſe, and then opening your compaſſe in the meaſure of your ſcale to ſo many feete as are in that meaſured height, fixe one foot of the ſame compaſſe vnaltred in the ſaid pricke marked (as I haue told you) in the ſayd figure with E, & with the other foot make another pricke vpon the ſaid perpendicular line, which ſhall for a difference be named the ſecond pricke, and is marked in the figure following with D. After this put the fiduciall edge of your ruler to the ſaid firſt pricke, and keeping it there, turne the ruler to or fro till you may behold thorough the ſaid grooue or chanell the extreme or end of the deſired diſtãce marked in the ſaid figure with A, and when you haue ſo done, draw with a keeler or cole by the ſaid fiduciall edge a right line that may point directly frõ the firſt prick vnto the fardeſt end of the deſired diſtance, as doth the line E F in the ſaid figure. This being done draw with a keeler or cole by the fiduciall edge of your



ruler a ſquire line from the ſaid ſecond prick vnto the line that pointeth from the firſt pricke to the ende of the deſired diſtance (which ſquire line is D F in the ſaid figure,) and note where this ſquire line cutteth or toucheth the other

line that pointeth from the firſt pricke to the ende of the meaſured diſtance, for now by opening againe the feete of your compaſſe to the ſpace betweene the ſaid interſection marked in the ſaid figure with F, and the ſecond pricke marked in the ſaid figure with D, and applying them in that meaſure or wideneſſe to the diuiſions of your ſcale, you may ſay that there are ſo many feete in the deſired horizontall diſtance, are there are deuiſions in your ſcale betweene the two feete of your compaſſe. In like maner by opening the feete of your compaſſe to the wideneſſe betweene the ſaid interſection and the firſt pricke, and applying them in that meaſure or wideneſſe to the deuiſions of your ſcale, you may know how manie feete are in the deſired hypothenuſal diſtance: that is to ſay, in the ſlope diſtance betweene the firſt pricke, and the extreme or end of the meaſured diſtance marked in the ſaid figure with E A.

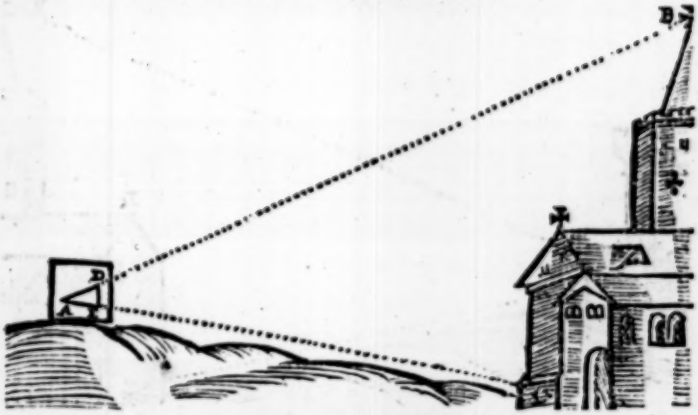
CHAP. VII.

To meaſure at one ſtation without arithmeticall calculation, a diſtance betweene an appointed place, and the vnuiſible baſe of a tower, or any other height whoſe top may in the appointed place be ſeene, and whoſe altitude from the vnuiſible baſe to the viſible top is knowne

MEASVRE vpon your geometricall table by the doctrine taught in the fourth chapter of this booke, how farre the viſible top of the height whoſe baſe can not be ſeene, and whoſe perpendicular length is knowen vnto you, lieth from the appointed place, and afterwards ſet your table faſt and vpright vpon one end in the appointed place, ſo as when the flatte ſide of your ruler lieth cloſe vpon the face of your table, you may by mouing it vp or downe behold thorough the grooue or chanell of the ruler, the top of the ſaid height which here ſhall be a tower marked in the figure following with B, and the impediment betweene your viſuall line and the vnuiſible baſe of the ſaid tower. Moreouer make a fine pricke vpon the face of the table to repreſent in your worke the appointed place, and putting the fiduciall edge at one ende of your ruler cloſe to the ſame pricke, keepe it there, and turne the other end of your ruler to or fro, till you may ſee thorough the ſaid chanell or grooue the top of the tower: which done draw with a keeler or cole by the ſaid fiduciall edge, a right line that may point directly from the ſaid pricke to the top of the ſayd tower, and then open your compaſſe in the meaſure of your ſcale, to the number of feete in the meaſured diſtance betwene the ſaid appointed place, and the top of the tower, and ſetting one foote of the compaſſe vnaltred in the ſaid pricke called for a difference the firſt pricke, and marked in the ſaid figure with A, make with the other foote of the ſame compaſſe a ſecond pricke in the ſayd right line: which ſecond pricke is marked in the ſaide figure with D. From this ſecond pricke draw downewards with a keeler, or cole, a perpendicular line, and after that opening

meane here the face of e table, the per which co- with the table

opening your compaſſe againe in the meaſure of your ſcale, to the number of feete in the knowne height betweene the viſible top of the tower, and the vnuiſible baſe of the ſame tower, fixe one foote of the ſame compaſſe vnaltred in the ſecond pricke, and with the other foote of the ſame compaſſe make a third pricke in the ſaid perpendicular line, which third pricke in the ſaid figure is marked with E, and draw with a keeler or cole by the fiduciall edge of your ruler, a right line from the firſt pricke to the third pricke: which done open the feet of your compaſſe to the length betweene the firſt pricke and the third pricke, and applying them in that meaſure or wideneſſe to the deuiſions in your ſcale, you may truly ſay that there are ſo many feete in the diſtance betweene the appointed place marked in the ſaid figure with A, and the vnuiſible baſe of the tower marked in the ſaid figure with C, as there are diuiſions in your ſcale betweene the two feete of your compaſſe.



CHAP. VIII.

To meaſure from an appointed height without arithmeticall calculation, a diſtance betweene the baſe of that appointed height, and the vnuiſible baſe of another height whoſe top may be ſeene.

MEASVRE vpon your geometrical table as you haue bene taught in the firſt chapter of this booke the diſtance lying betweene the baſe of the appointed height on which you ſtand marked in the figure folowing with A, and the viſible top of the other known height marked in the ſaid figure with B. and for the reſt of this worke do as you haue learned in the 7. chapter of this booke: ſo you ſhall obtaine your deſire. And therewith this is to be noted, that the art taught in this 8. chapter and in the former chapters (videlicet in the 4. 5. 6. & 7.

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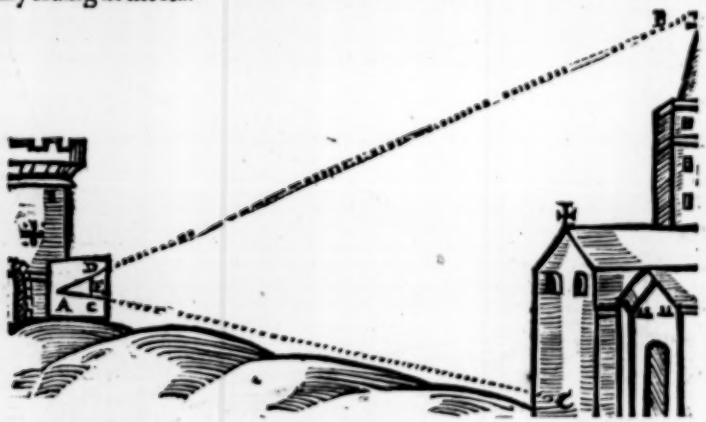
chapters of this firſt booke) reuealeth the length of wayes, the diſtance between places, the time in which an armie may march from one place to another, and whether an armie marching by a caſtle is within danger of ſhot from the ſaid caſtle. Alſo the ſame art will teach you to pitch a maine battle in the neareſt place where no ſhot from any caſtle or fort ſhal do hurt, and to know the exact bredth of any riuer or water, whereby you may cauſe bridges to be made vpon which an armie may ſafely paſſe ouer. Moreouer by that art you may with any peece of artillerie ſtrike markes at randon within the reach of your peece, plant great ordinance in conuenient places for batteries, giue infallible inſtructions for mynes, bouge ſhippes lying at rode in the ſea or ſailing in the ſea within the reach of your ordinance, and caſt ancor at the ſea out of danger of ſhot from any ſconce or platforme vpon the land, and from any ſhippe or gally riding in the ſea.

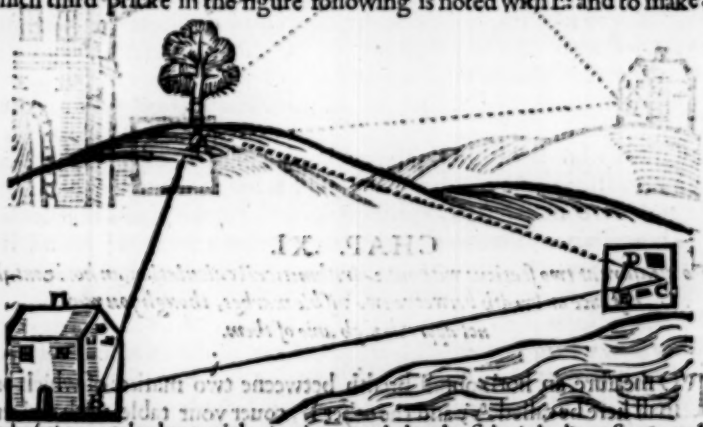


CHAP. IX.

To meaſure without any Arithmeticall calculation, a bredth or diſtance (be it horizontall or hipothenuſall) betweene two viſible markes though you may not by reaſon of riuers, or ſuch like impediments, approch nigh any of them.

TO meaſure vpon a Geometricall table without Arithmeticall calculation, a bredth or diſtance (be it horizontall or hipothenuſall) betweene two viſible markes which we will here name A and B, you ſhall meaſure by the doctrine taught in the 4. chapter of this booke, how farre A, one of thoſe markes lieth from an appointed place that ſhall here be named C, and how far B the other mark is from the ſaid place C. This done, lay your table flat, and vnmoueable vpon his

his foote faſt fixed in the ſaid appointed place, and hauing made a pricke vpon the face of the table, or (which is all one) vpon the paper which couereth your table, to repreſent in your worke the appointed place C, lay the fiduciall edge at one end of your ruler vnto the ſaid pricke noted in the figure following with C, and keeping the ſame edge there, turne the other end of your ruler to or fro, till you ſhall eſpie thorow the grooue or channell of the ſame ruler, the marke A, and then draw with a keeler or cole, by the ſaid fiduciall edge, a right line that may point from C the firſt pricke, vnto the marke A ſo eſpied. After al this, keeping ſtil the edge of your ruler vpon C the firſt prick, turne your ruler againe, till you ſhall eſpie thorow the ſaid grooue, or channell, the other marke B, and then as you did before draw from C the firſt pricke, by the ſaid fiduciall edge, another right line that may point directly to B the marke laſt eſpied. Now opening your compaſſe in the meaſure of your ſcale, to the number of feete in the length betweene C the appointed place, and the marke A, ſet one foote of the ſame compaſſe vnaltered in C the firſt pricke, and with the other foote of the ſame compaſſe, make a ſecond pricke in the line that pointeth from the firſt prick to the ſaid mark A, which ſecond pricke in the figure following is D. Againe opening your compaſſe in the meaſure of your ſcale, to the number of feete in the length betweene C the appointed place, and B the other marke, put one foote of the ſame compaſſe vnaltered in C the firſt pricke, and with the other foote, make a third pricke in the right line that pointeth from the firſt pricke to B the ſaid mark, which third pricke in the figure following is noted with E: and to make an



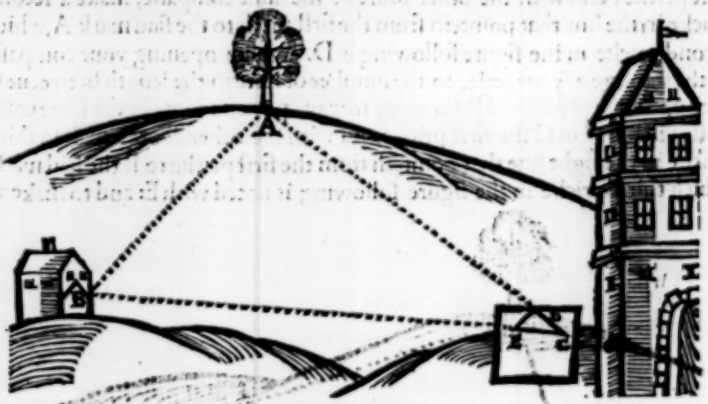
end of this work, draw with a keeler or cole by the fiducial edge of your ruler a right line from the ſecond prick to the third prick; for now by opening the feete of your compaſſe to the wideneſſe betweene the ſecond prick and third pricke, and applying them in that meaſure or wideneſſe, to the diuiſions in

your ſcale, you may truly ſay, that there are ſo many feete in the bredth betweene A and B the ſaid two markes, as there are diuiſions in your ſcale betweene the two feete of your compaſſe.

CHAP. X.

To meaſure by another way from an height without Arithmeticall calculation, a bredth or diſtance betweene two markes howſoeuer they be ſituated, though you may not approch nigh any of them.

MEASVRE vpon your geometrical table (as you haue bene taught in the fift chapter of this booke) the diſtance betweene C the baſe of the height on which you ſtand, and A one of the markes: alſo meaſure the diſtance betweene the ſaid C and B the other marke, and in the reſt of this worke do as you haue bin taught in the ninth chapter of this booke, ſo ſhall you obtaine your deſire.



CHAP. XI.

To meaſure at two ſtations without Arithmeticall calculation, an horizontall diſtance or bredth betweene two viſible markes, though you may not approch nigh anie of them.

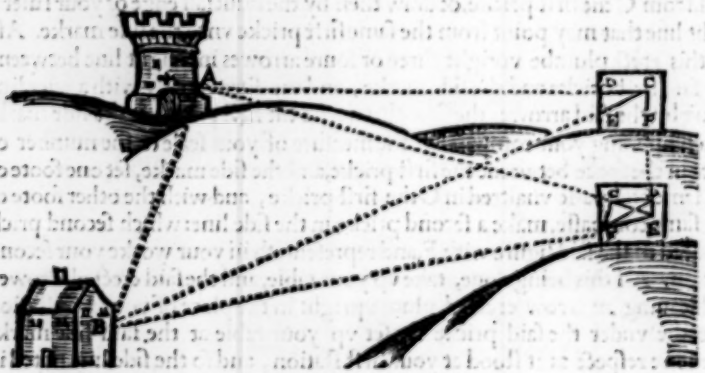
TO meaſure an horizontall bredth betweene two markes of which one ſhall here be called A, and the other B, couer your table with a cleene white ſheete of paper, lay the paper ſmooth, and faſt vpon the table by the helpe of the frame which ſerueth for that purpoſe, and hauing ſet the table flat and vnmooueable vpon his foote faſt fixed in a conuenient place for your firſt ſtation, make a pricke vpon the paper or face of the table to repreſent in this

worke

worke your firſt ſtation: which pricke for a difference ſhall here be called the firſt pricke, and be noted in the figure following with C. After this put the fiduciall edge at one end of your ruler to the ſaid pricke, and keeping it there; turn the other end of your ruler to or fro, til you may eſpie thorow the grooue or channell of the ruler the marke A, and then draw by the ſaid fiduciall edge a right line that may point from C the firſt pricke vnto A the ſaid marke, as the line C D doth in the ſaid figure. Againe keeping ſtill the fiduciall edge at one end of your ruler vpon the firſt pricke, turne the other end of your ruler to or fro, till you may ſee thorow the ſaid grooue or channel, the other marke B: which done, draw by the ſaid fiduciall edge a right line that may point from C the firſt pricke, vnto B the other marke, as the line C E doth in the ſaid figure. Now the fiduciall edge at one end of your ruler ſtill remaining vpon C the firſt pricke, turne the ruler about till you may behold thorow the ſaid grooue or channell a ſide marke in a conuenient diſtance of which hand you will, from C the firſt pricke, & draw then by the fiduciall edge of your ruler a right line that may point from the ſame firſt pricke vnto the ſide marke. After this erect plumbe vpright three or foure arrowes in a right line betweene the ſaid firſt pricke and the ſide marke, and meaſure exactly with a wier line along by the ſaid arrowes, the ſpace betweene the firſt pricke & the ſide mark. Then opening your compaſſe in the meaſure of your ſcale to the number of feete in the ſpace betweene the firſt pricke, and the ſide marke, ſet one foote of the ſame compaſſe vnaltred in C the firſt pricke, and with the other foote of the ſame compaſſe, make a ſecond pricke in the ſide line: which ſecond prick is noted in the ſaid figure with F, and repreſenteth in your worke your ſecond ſtation. All this being done, take vp your table, and the ſaid erected arrowes, and leauing an arrow erected plum vpright in the place of your firſt ſtation directlie vnder the ſaid pricke C, ſet vp your table at the ſaid ſide marke in euerie reſpect as it ſtood at your firſt ſtation, and ſo the ſide line noted in the ſaid figure with F C, will at your ſaid ſide marke and ſecond ſtation, point directly to the arrow erected at your firſt ſtation, and C the firſt pricke will ly directly in a right line betwene the ſecond pricke and the ſaid arrow at your firſt ſtation. This done put the fiducial edge of your ruler to the ſecond prick noted in the ſaid figure with F, and in the ſame order as I haue taught you to draw at your firſt ſtation two right lines of which one pointed from the firſt pricke to the marke A, and the other to the marke B, draw at your ſecond ſtation two like lines which may point from the ſecond pricke vnto the ſaid markes A and B, as do the two lines F D and F E in the tipe of the table at the ſecond ſtation in the ſaid figure. After all this looke aduiſedly where the line which pointed from the firſt pricke vnto the marke A, meeteth with the line that pointeth from the ſecond pricke vnto A the ſaid marke: and likewiſe looke where the line which pointed from the firſt pricke vnto the marke B, meeteth with the line that pointeth frō the ſecōd pricke vnto the ſaid marke

B, for now by opening the feete of your compaſſe vnto the ſpace betweene thoſe meetings of lines, and applying them in that meaſure or wideneſſe to the diuiſions in your ſcale, you may affirme that there are ſo many feete in the horizontall bredth betweene the ſaid two markes A and B, as there are diuiſions in your ſcale betweene the two feete of your compaſſe.

The art which hath bene taught in this eleuenth chapter, & in the two former chapters (videlicet in the ninth and tenth chapters of this firſt booke) ſheweth the true diſtance betweene any two or a more number of ſconces, caſtles, or other places, wherby you may iudge truly whether or no an army can paſſe betweene them without danger of their ſhot. Alſo by this art you may giue a neere geſſe at any time and in al places if you ſhal ſee men in battle ray, what number is of them, which are things in militarie ſeruice both commendable and profitable.



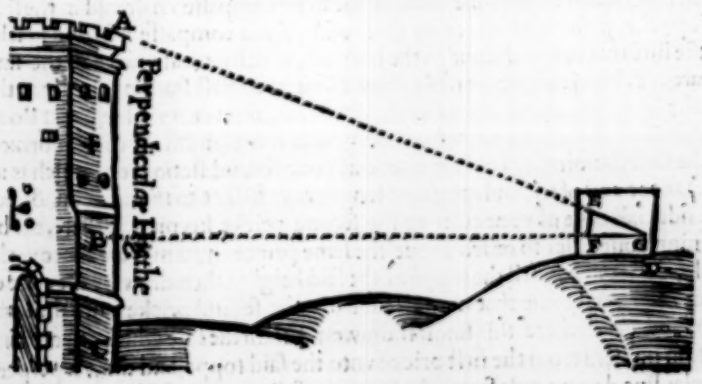
CHAP. XII.

To meaſure at one ſtation without Arithmeticall calculation, an acceſſible and perpendicular height.

PLACE your geometricall table couered with paper vpright and vnmoueable vpon one ende, ſo as you may behold thorow the groue or chanell of your ruler laid flatlong cloſe to the face of the table, the top and baſe of the acceſſible and perpendicular height to be meaſured. Moreouer meaſure with your wyer line the diſtance betweene the foote of your table and the baſe of the ſaid height: and here note that the place where the foote of your table by ſuppoſall ſhall be fixed, is marked in the figure following with D, and that the baſe of the ſaid height is marked in the ſaid figure with C, and that the toppe of the ſaid

height

height is marked in the ſaid figure with A. After this draw a perpendicular line noted in the figure following with E F, vpon the face of the table in that part therof which is next to the ſaid height, & from the lower end of the ſame perpendicular line, draw a ſquier line towards your ſelfe, I meane towards that part of the table which is moſt fartheſt from the ſaid height: then opening your compaſſe in the meaſure of your ſcale to the number of feete betweene the baſe of the ſaid height, and the foote of your table, ſet one foote of your compaſſe vnaltred in the lower end of the ſaid perpendicular line, and with the other foote of the ſame compaſſe make a pricke in the ſaid ſquier line, which pricke is noted in the ſaid figure with G. & repreſenteth in your work the place where the foote of your table is fixed. Now putting the fiducial edge of your ruler to the ſaid pricke, and keeping it there, turne the other end of your ruler to or fro, till you may behold thorow the ſaid groue or channell the toppe of the ſaid height: this done, draw a right line by the ſaid fiduciall edge that may point directly from the ſaid pricke vnto the toppe of the ſame height, and note diligently where this line laſt drawne cutteth the perpendicular line: for now by opening your compaſſe to the ſpace betweene the lower end of the perpendicular line and the ſaid interſection, and applying them in that meaſure or wideneſſe to the diuiſions in your ſcale, you may affirme that there are ſo many feete betweene the top and that part of the perpendicular height which lieth leuell with the ſaid pricke, and is marked in the ſaid figure with B, as there are diuiſions in your ſcale betweene the two feet of your compaſſe, & that by adding the number or meaſure of feete betweene the ground and the ſaid pricke, vnto the number or meaſure of feete alreadie found in the ſaid part of the deſired height: the iuſt number and meaſure of feete in the whole perpendicular altitude may be knowne.



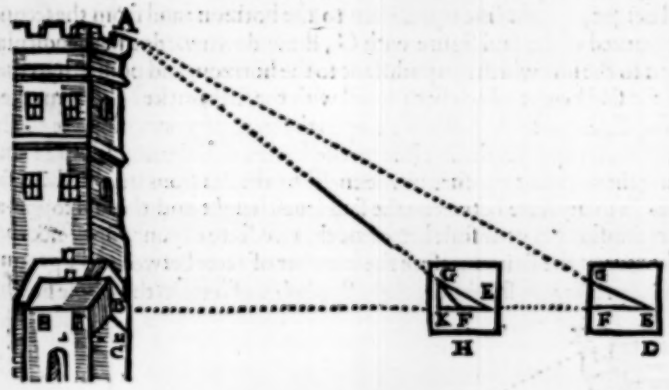
CHAP. XIII.

How you ſtanding on a plaine maie meaſure at two ſtations without Arithmeticall calculation a perpendicular height, though you cannot approch vnto it by reaſon of riuers, or ſuch like impediments.

OVR table being couered with paper, and ſet faſt vpright vpon one ende in a conuenient place of the plaine (marked in the figure following with D) from whence you may behold thorow the grooue or chanel of your ruler turned to or fro the toppe of the height to be meaſured marked in the ſaid figure with A, and the baſe of the ſame height marked in the ſaid figure with C, make a pricke vpon the face of the table ſomewhat aboue the lower ende of the table & in that part thereof which is next vnto you, or (which is all one) fartheſt from the deſired height, to repreſent in this worke your firſt ſtation: that is to ſay the place where your table now ſtandeth. To this firſt pricke marked in the ſaid figure with E, drawe a right line equidiſtant to the horizon that may point from the ſame firſt pricke vnto that part of the ſaid height which lieth leuell with the ſame pricke: which leuell height is noted in the ſaid figure with B. Then putting the fiduciall edge of your ruler to the ſaid pricke, and keeping it there, turne your ruler to or fro, till you may eſpie thorow the ſaid grooue or channell the toppe of the ſaid height: which done draw by the ſaid fiduciall edge a right line that may point from the ſaid firſt pricke vnto the ſaid toppe. After this, meaſure with a wire line directly from the point of groũd lying vnder the ſaid firſt prick towards the baſe of the ſaid height, a length of 40. or 50. feete more or leſſe at your pleaſure, and ſetting vp a marke at the end of this length which in the ſaid figure is H, open your compaſſe in the meaſure of your ſcale to the number of feete in the ſaid meaſured length, and ſetting one foote of the ſame compaſſe vnaltered in the ſaid firſt pricke, make with the other foote of the ſame compaſſe a ſecond pricke in the line that is equidiſtant to the horizon, which ſecond pricke in the ſaid figure is F. Now taking the table away from your firſt ſtation, place it at the marke ſet vp in the end of the ſaid meaſured length, in euery reſpect as it ſtood at your firſt ſtation, ſo as the ſaid line which was equidiſtant to the horizon at the firſt ſtation may be now againe at your ſecond ſtation, or (which is all one) at the end of the ſaid meaſured length equidiſtant to the horizon, & put the fiduciall edge of your ruler to the ſecond pricke, keeping it there, till by turning your ruler to or fro about the ſame pricke, you may ſee thorow the ſaid grooue or channell the toppe of the ſaid height: then draw by the edge of your ruler a right line that may point from the ſecond pricke vnto the ſame top, and note where this line laſt drawen cutteth the line which at your firſt ſtation pointed from the firſt pricke vnto the ſaid toppe, and draw a perpendicular line downwards from the ſaid interſection vnto the line equidiſtant

to

to the horizon. Laſt of all open the feete of your compaſſe to the length of the ſaid perpendicular line marked in the ſaid figure with G K, & applying them in that meaſure or widneſſe to the diuiſions in your ſcale, ſay there are ſo many feete betweene the ſaid leuell height and the ſaid toppe, as there are diuiſions in your ſcale betwene the two feete of your compaſſe, and that by adding therunto the number of feete betweene the ground and the ſecond pricke, the iuſt number of feet in the whole height will be knowen.

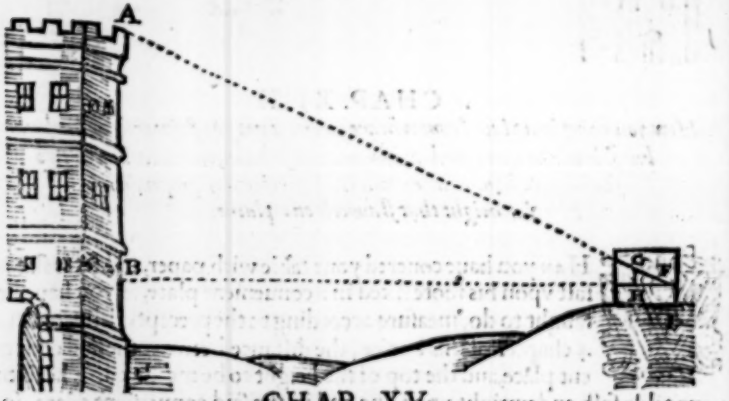


CHAP. XIIII.

How you being in a place from whence you may not goe forwards or backwards but ſidewiſe to the right hand, or to the left hand, may meaſure at two ſtations without arithmeticall calculation any perpendicular height that ſtandeth on a plaine.

WHEN you haue couered your table with paper, and ſet it flat, and faſt vpon his foote fixed in a conuenient place, as you haue bene taught to do, meaſure according to the precepts deliuered in the 4 chapter of this booke, the diſtance betwene the ſaid conuenient place, and the top of the height to be meaſured. The ſetting your table faſt, and vpright vpon one end in the ſaid conuenient place, ſo as after the flat ſide of your ruler is laid cloſe vnto the face of the table, you may by mouing it vp or downe, ſee the top and baſe of the height to be meaſured, make vpon the face of your table a pricke, which for a difference ſhall be called the firſt pricke, and be marked in the ſaid figure with F. To this pricke lying directly ouer the ſaid conuenient place marked in the ſaid figure with E, put the fiduciall edge at one end of your ruler, and keeping it there, turne the other end of your ruler to or fro, till you may ſee thorow the groue or chan-

nell of your ruler the toppe of the ſaid height, and afterwards drawe by the ſaid fiduciall edge a right line that may directly point from the ſaid pricke vnto the toppe of that height. Now opening your compaſſe in the meaſure of your ſcale to the number of feete in the diſtance betweene the ſaid prick, & the ſaid toppe, fixe one foote of the ſame compaſſe vnaltered in that firſt prick, and with the other foote of the compaſſe make a ſecond pricke in the line laſt drawne: which ſecond pricke is marked in the ſaid figure with G. This done draw vnto the firſt pricke from that ſide or end of the table which is next to the ſaid height, a right line equidiſtant to the horizon: and from the ſecond pricke marked in the ſaid figure with G, draw downwards a perpendicular line euen to the line which is equidiſtant to the horizon, and pointeth to that part of the ſaid height which lieth leuell with the firſt pricke, and is marked in the ſaid figure with B. Laſt of all open the feete of your compaſſe to the length of the ſaid perpendicular line marked in the ſaid figure with G H, and applying them in that meaſure or wideneſſe to the diuiſions in your ſcale, ſay there are ſo many feete betweene the ſaid leuell height and the ſaid toppe, as there are diuiſions in your ſcale betweene the two feete of your cõpaſſe, & that by adding vnto the ſame meaſure the number of feete betweene the ground & the firſt pricke, you ſhal know the iuſt number of feete in the whole height.



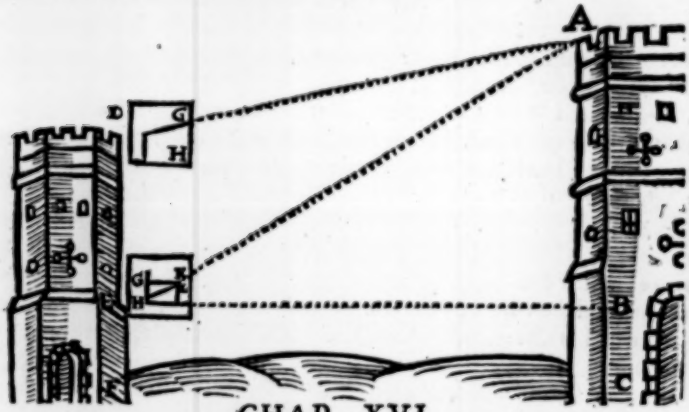
CHAP. XV.

Howw you ſtanding vpon a perpendicular height ſcituated on a plaine from vvhence you cannot go forvvards, backvvards, or ſidevvise, may meaſure at tvvo ſtations vvithout Arithmeticall calculation, an other perpendicular height ſcituated on the ſame plaine.

IF you ſtanding vpon a perpendicular height, which in the figure following is marked in the toppe with D, below towards the baſe with E, and at the baſe with F, will meaſure another perpendicular height marked in the ſaid figure

figure at the toppe with A, below towards the baſe with B, and in the baſe with C, and ſhall perceiue that both the ſame heigths are ſcituated on a plain of an equall heigth, you muſt ſet your table vpright and faſt vppon one end at D the toppe of the heigth on which you ſtand, ſo as the flat ſide of your ruler being laid cloſe to the face of the table, you may by turning it about, ſee thorow the grooue or channell in the ſaid ruler, F the baſe of the heigth on which you ſtand, A the toppe of the heigth to be meaſured, and C the baſe of the heigth to be meaſured. This done make a pricke vpon the face of the table at that end or ſide which is next vnto you, which pricke in the figure following is marked with G, and from that pricke draw a perpendicular line downewards. Alſo putting the fiducial edge at one end of your ruler vnto that prick, and keeping it there, moue the other end of the ruler vp or downe, till you may ſee thorow the ſaid grooue or channell A, the toppe of the height to be meaſured, and then draw by the ſaid fiduciall edge a right line that may point from the ſaid pricke (which for a difference ſhall be called the firſt pricke) vnto the ſaid A. When you haue ſo done meaſure with your wyer line the ſpace betweene the firſt pricke and that place in the ſaid height D F where you will make your ſecond ſtation, which place in this worke ſhall be ſuppoſed to be E, and opening your compaſſe in the meaſure of your ſcale to the number of feete in the ſaid ſpace ſo meaſured with your wier line, fixe one foote of the ſame compaſſe vnaltered in the firſt pricke, & with the other foote of the ſame compaſſe make a ſecond pricke in the ſaid perpendicular line, which ſecond pricke in the ſaid figure is H. Now tranſport your table vnto that place which in the ſaid figure is marked with E, and ſet it there in euery reſpect as it ſtood at D, and ſo as the ſaid ſecond pricke may lie in a leuell line with E the loweſt end of that meaſured ſpace. Then putting the fiduciall edge at one end of your ruler to the ſecond pricke, and keeping it there, moue the other end of the ruler vp or downe, till you may behold againe thorow the ſaid grooue or channell the ſaid A: which done draw by the ſaid fiduciall edge a right line that may point from the ſecond pricke vnto the ſaid A, and note where this line laſt drawne cutteth the other line which at D your firſt ſtation pointed from the firſt pricke vnto the ſaid A. After all this draw from that interſection marked in the ſaid figure with K a perpendicular line downewards, and from the ſecond pricke draw a right line equidiſtant to the horizon, euen vnto the ſaid perpendicular line. This line equidiſtant to the horizon pointeth to that part of the heigth A C which lieth leuell with the ſecond pricke and is marked in the ſaid figure with B. Finally open the feete of your compaſſe to the length of the perpendicular line laſt drawne, marked in the ſaid figure with K L, and applying them in that wideneſſe to the diuiſions in your ſcale, ſay there are ſo many feete betweene the ſaid B and A, as there are diuiſions in your ſcale betweene the two feete of your compaſſe, and that by adding thervnto the number of feete betweene the ground & the ſecond prick, or (which

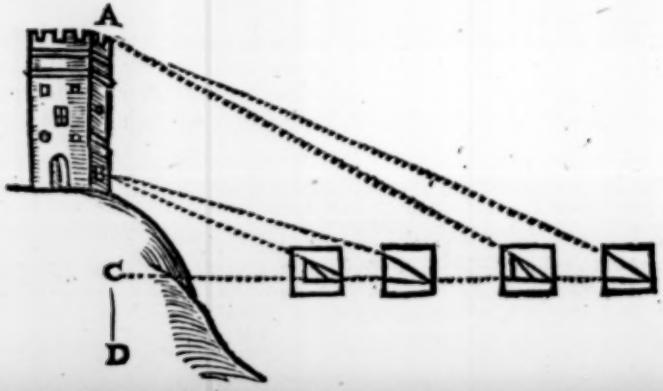
is all one) betweene the ground and the ſaid marke E, you ſhall know the iuſt number of feete in the whole deſired heigth A C.



CHAP. XVI.

How you ſtanding on the ground may meaſure at two ſtations an heigth ſcituated vpon another heigth, as the altitude of a tower ſcituated on a hill, or the length of a ſteeple aboue the battlements, or the diſtance betweene ſtorie and ſtorie in buildings, ſf the toppe and baſe of the heigth to be meaſured may be ſeene.

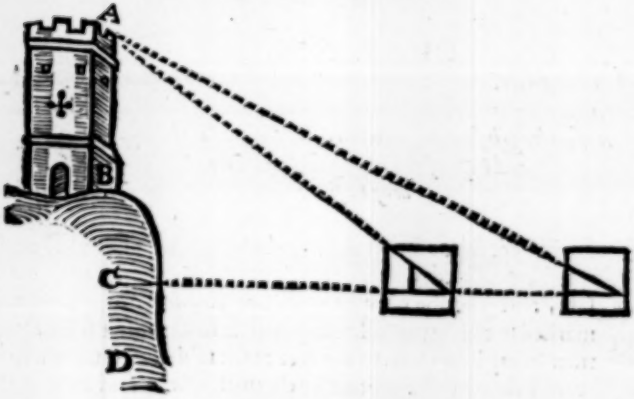
TO know the height of A B a tower ſtanding on B D a hil, meaſure the whole heigth of the ſaid tower and hil (that is to ſay the heigth of A D) by the art taught in the 13. chapter of this book. Alſo meaſure by the art taught in the ſame chapter the heigth of B D the ſaid hill, ſubtract the heigth of B D from the heigth of A D, and ſo the remainer will ſhew the height of A B the tower.



CHAP. XVII.

How you ſtanding on a plaine, from whence you cannot go forwards or backwards, but ſidewiſe to the right hand, or left hand, may meaſure at two ſtations an heigth ſtanding vpon another heigth.

TO know the altitude of A B a tower ſtanding on B D a hill meaſure by the art taught in the fourteenth chapter of this booke the whole heigth of the ſaid tower and hill: that is to ſay the whole height of A D. Likewiſe meaſure by the art taught in the ſaid fourteenth chapter the heigth of the hil B D: ſubtract the heigth of B D out of the heigth of A D, and ſo the remainer wil ſhew the heigth of A B the tower.

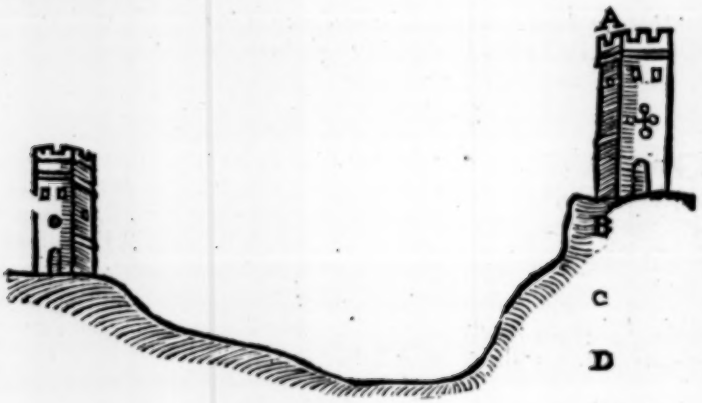


CHAP. XVIII.

How you ſtanding on a heigth from whence you cannot go forwards, backwards, or ſidewiſe, may meaſure at two ſtations an altitude ſcituated on another altitude.

TO know the altitude of A B a tower ſcituated on B D a hill, meaſure by the art taught in the fifteenth chapter of this book, the whole heigth of the ſaid tower and hill: that is to ſay, the whole heigth of A D. Likewiſe meaſure by the art taught in the ſaid fifteenth chapter, the heigth of the hill B D, ſubtract

the heigth of B D out of the heigth A D, and ſo the remainer will ſhew the heigth of A B the tower.

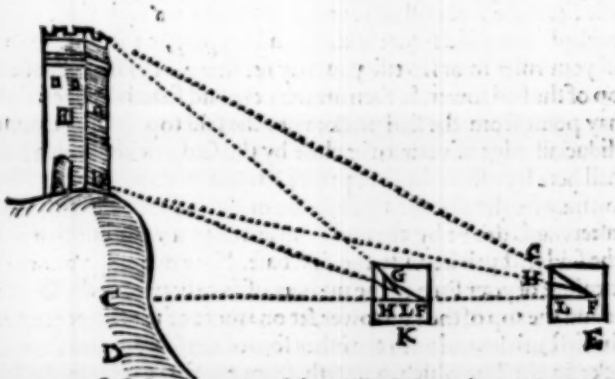


CHAP. XIX.

How you ſtanding on a plaine ground from whence you can go forwards, or backwards, may meaſure at two ſtations without Arithmeticall calculation an heigth ſtanding vpon an other heigth, if the toppe and baſe of the heigth to be meaſured may be ſeene.

WE will here ſuppoſe that A B a tower ſtanding vpon B D a hill, is to be meaſured, wherefore ſet your table couered with paper faſt, and plumbe vpright vpon one end at your firſt ſtation marked in the figure following with E, ſo as the flat ſide of your ruler being laid cloſe to the face of the table, and turned to or fro, you may behold thorow the grooue or channell of the ſaid ruler A the toppe of the tower, B the baſe of the ſaid tower, and the ground at your firſt ſtation marked with E. After this make a pricke vpon the face of the table, and for a difference call this pricke (marked in the ſaid figure with F) the firſt pricke. Moreouer putting the fiduciall edge at one end of your ruler cloſe to the ſaid firſt pricke, and keeping it there turne the other end of your ruler about that pricke till you may ſee thorow the ſaid grooue or channell A the toppe of the ſaid tower: which done, draw by the ſaid fiduciall edge a right line that may point from the ſaid firſt pricke vnto the ſaid A. Againe keeping ſtill the fiduciall edge of your ruler cloſe by the ſaid pricke, turne it about the ſame firſt pricke, till you haue eſpied thorow the ſaid channell, B the baſe of the ſaid tower, and then draw by the ſaid fiduciall edge a right line that may

may point from the ſaid firſt pricke vnto the ſaid B. Alſo meaſure with your wier line from E your firſt ſtation towards D the baſe of the ſaid hill, a length of fortie or fiftie feete, more or leſſe at your pleaſure, and ſetting vp an arrow at the end of that length, name the place where the arrow is ſo ſet your ſecond ſtation marked in the ſaid figure with K. After this draw by the fiduciall edge of your ruler from that ſide of the table which is next to the ſaid hill, vnto the firſt pricke a line equidiſtant to the horizon, and opening your compaſſe in the meaſure of your ſcale to the number of feete in the ſpace meaſured with your wyer line, ſet one foote of the ſame compaſſe vnaltred in the firſt pricke, and with the other foote make a ſecond pricke in the ſaid line equidiſtant to the horizon: which ſecond pricke is marked in the ſaid figure with L. All this being done, tranſport your table to the end of the ſaid meaſured length, and ſet there your table faſt, and plumbe vpright vpon one end in euery reſpect as it ſtood at your firſt ſtation, ſo as the ſaid ſecond pricke may be perceiued to lie directly ouer the point of ground where the ſaid arrow did ſticke, and that the line which was equidiſtant to the horizon at your firſt ſtation, be equidiſtant to the horizon at your ſecond ſtation, and afterwards as you did draw at your firſt ſtation by the fiduciall edge of your ruler one right line that did point from the firſt pricke vnto the ſaid A, and another right line which did point from the ſaid firſt pricke vnto the ſaid B, ſo draw at this your ſecond ſtation by the ſaid fiduciall edge, one right line that may point from the ſecond pricke vnto the ſaid A, and another right line that may point from the ſaid ſecond pricke vnto the ſaid B, and noting diligently where the line which pointeth at your ſecond ſtation from the ſecond pricke to A croſſeth the line



that at your firſt ſtation pointed from the firſt pricke to the ſaid A, and likewiſe where the line which pointeth at your ſecond ſtation from the ſecond pricke to B croſſeth the line that at your firſt ſtation pointed from the firſt,

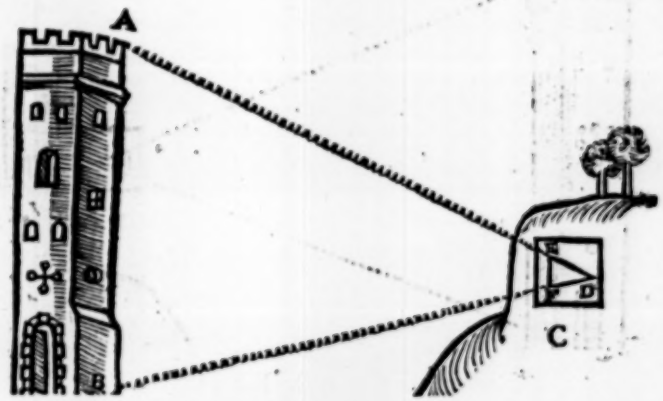
pricke vnto the ſaid B, draw a right line from one croſſing of like lines to the other croſſing of like lines. Laſt of all open the feete of your compaſſe to the length of the line betweene the ſaid croſſings marked in the ſaid figure with G H, and applying them in that meaſure or wideneſſe to the diuiſions in your ſcale, ſay there are ſo many feet in the deſired heigth of A B the tower, as there are diuiſions in your ſcale betweene the two feete of your compaſſe.

CHAP. XX.

How you may meaſure without Arithmeticall calculation a perpendicular heigth ſcituated on a plaine lower than the ground on which you ſtand, if you may ſee the toppe and baſe thereof.

IF you will meaſure an heigth which here ſhalbe ſuppoſed to be a tower ſcituated on a plaine lower than the ground where you ſtand, & may ſee from your ſtations the top and baſe of the ſaid tower, do thus. Meaſure vpon your table by the art taught in the fourth chapter of this booke, the diſtance betweene an appointed place (marked in the figure following with C) and the top of the ſaid tower marked in the ſaid figure with A. Alſo meaſure by the art taught in the ſaid fourth chapter, the diſtance betweene the ſaid appointed place & the baſe of the ſaid tower marked in the ſaid figure with B. This done, ſet your table plumbe vpright vpon one end in the ſaid appointed place, ſo as by laying the flat ſide of your ruler cloſe to the face of the table, and by turning it about cloſe by the ſaid face, you may ſee thorow the grooue or chanell of the ſaid ruler the top and baſe of the ſaid tower. After this, make a pricke vpon the face of the table, put the fiduciall edge at one ende of your ruler cloſe to the ſaid pricke marked in the ſaid figure with D, and keeping it there, turne the other ende of your ruler to or fro till you may ſee thorow the ſaid grooue or chanell the top of the ſaid tower, & then draw by the ſaid fiduciall edge a right line which may point from the ſaid pricke vnto the ſaid top. In like manner keeping the fiduciall edge of your ruler cloſe by the ſaid pricke (which for a difference ſhall here be called the firſt pricke) turne it about the ſame firſt pricke, till you may ſee thorow the ſaid grooue or chanell the baſe of the ſayd tower, and afterwards drawe by the ſaid fiduciall edge a right line that may point from the ſaid firſt pricke vnto the ſaid baſe. Now opening your compaſſe in the meaſure of your ſcale to the number of feete betweene the ſaid appointed place and the top of the ſaid tower, ſet one foote of the ſame compaſſe vnaltred in the firſt pricke, and with the other foot of the ſame compaſſe make a ſecond pricke in the line which pointeth from the firſt pricke to the ſaid top, which ſecond pricke is marked in the ſaid figure with E, & then opening your compaſſe againe in the meaſure of your ſcale to the number of feet in the diſtance betweene the ſaid appointed place and the baſe of the ſaid tower, ſet one

one foote of the ſame compaſſe vnaltred in the firſt pricke, and with the other foot of the ſame compaſſe, make a third pricke in the line which pointeth from the firſt pricke to the ſaid baſe, and drawe a right line from the ſecond pricke to the third pricke marked in the ſaid figure with F. When you haue done all this open the feete of your compaſſe againe to the length of the line betweene the ſecond and third prickes, and applying them in that wideneſſe or meaſure to the diuiſions in your ſcale, ſay there are ſo many feete in the deſired height of the ſaid tower, as there are diuiſions in your ſcale betweene the two feete of your compaſſe.

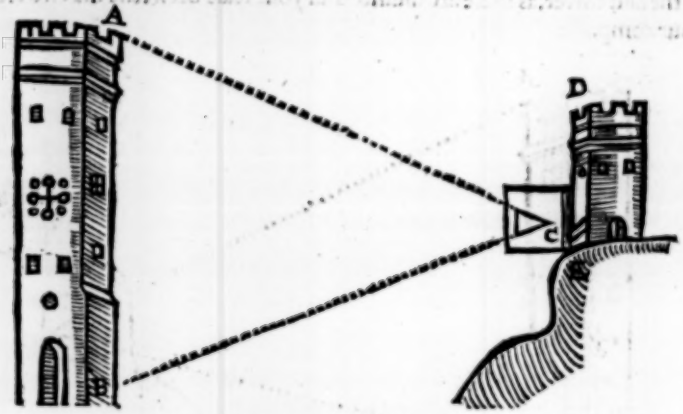


CHAP. XXI.

How you ſtanding vppon an heigth, and ſeeing there the toppe and baſe of an other heigth ſcituated on a plaine lower than the baſe of the heigth on which you ſtand, may meaſure without arithmeticall calculation the ſame other heigth.

THis heigth to be meaſured ſhall here by ſuppoſell be a tower marked in the figure following at the top with A, & at the baſe with B, & the heigth on which you ſtand ſhall here by ſuppoſel be another tower, marked in the ſaid figure at the top with D, and at the baſe with E, wherfore meaſure vpon your table by the arte taught in the fift chapter of this booke, the diſtance betweene the baſe of the tower on which you ſtand, and the top of the tower to be meaſured. Likwiſe meaſure by the arte taught in the ſaid fift chapter, the diſtance betweene the baſe of the tower in which you ſtand, and the baſe of the tower to be meaſured, and for the reſt of this worke ſetting your table plumbe vpright vppon one ende at the baſe of the tower on which you ſtood, doe as you haue bene

taught in the twenty chapter of this booke, and ſo you ſhall obtaine your deſire. By the art which before hath taught you to meaſure perpẽdicular heigths you may tell how many foote highe any tree doth beare timber, what ſpace is betwene ſtorie and ſtorie in any houſe or other building, what length ought to be in euery ſcaling ladder, and how high any mountaine, hill, rocke or other place is: a thing that euery gunner ought to know when he doth ſhoote at a marke vpon any ſuch height.



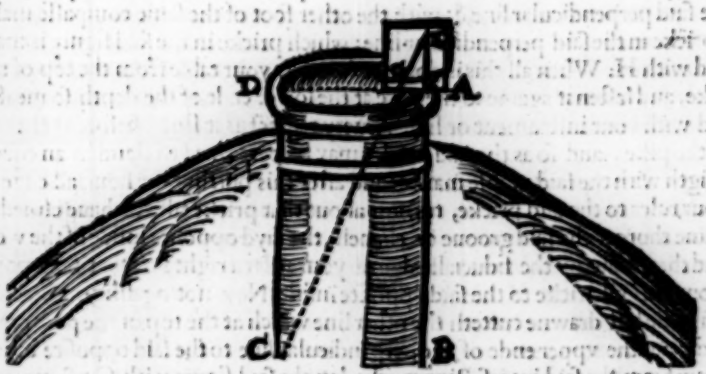
CHAP. XXII.

How you may meaſure without arithmeticall calculation the depth of a well.

SEt your table couered with paper faſt, and plumbe vpright (as before you haue bene taught to do) vpon the courbe of the well. ſo as more then halfe your table may be perceiued to hange ouer the inſide of the ſaid courbe and well, and that by laying the flat ſide of your ruler to the paper, and by turning it about cloſe by the ſaid paper, you may ſee thorow the grooue or chanell of the ruler, the bottome of the well in that ſide which lieth vnder a part of your table, and is marked in the figure following with B, and likewiſe the bottome in the oppoſite ſide of the well marked in the ſaid figure with C. This done, draw vpon the paper a perpendicular line right ouer the inſide of the ſaid well, and from the perpendicular ſide of the table which hangeth betweene the two inſides of the well, draw a ſquire line to the lower end of the ſaid perpendicular line. Moreouer meaſure the diameter of the well marked in the ſaid figure with A D., and opening your compaſſe in the meaſure of your ſcale to the number of feet in the length of that diameter, ſet one foote of the ſame compaſſe in the right angle which the

ſaid

ſaid two lines haue made, and I haue marked in the ſaid figure with F, and with the other foote of the ſame compaſſe, make a pricke in the ſaid ſquire line, which pricke marked in the ſaid figure with G, ſhall here for a difference be called the firſt pricke. After this putting the fiduciall edge of one part of your ruler cloſe by the ſaid firſt pricke, moue your ruler lying at one end, or at an other part of the ſaid fiduciall edge vpon the ſaid perpendicular line, vp or downe, till you may eſpie thorow the ſaid grooue or chanell, the ſaid bottome in the oppoſite ſide of the well marked in the ſaid figure (as before I haue told you) with C, and then making a ſecond pricke in that place of the ſaid perpendicular line which is touched with the fiduciall edge in that other part of the ruler, draw by the ſame fiduciall edge a right line that may point from the ſecond pricke to the firſt pricke, and alſo to the bottome in the oppoſite ſide of the well. When you haue done all this, open the feete of your compaſſe to the length betweene the ſaid right angle marked in the ſaid figure with F, and the ſecond pricke marked in the ſame figure with E, and applying them in that wideneſſe or meaſure to the diuiſions in your ſcale, ſay there are ſo many feete in the deſired depth of the well, as there are diuiſions in your ſcale betweene the two feete of your compaſſe.



CHAP. XXIII.

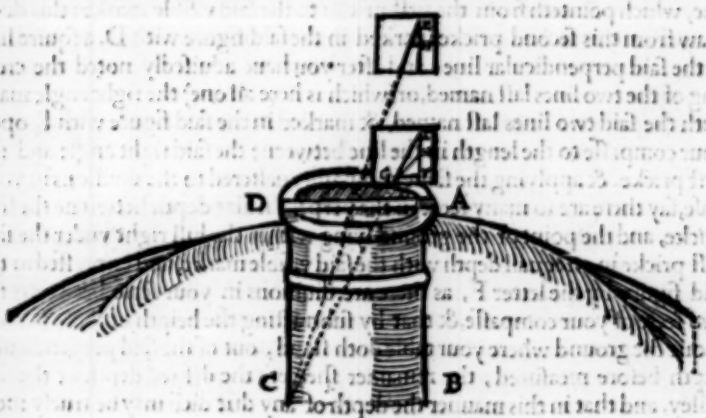
How you may meaſure by another way the depth of a well.

TAke a pike plumbe vpright in the courbe of the well, and aſcending by a ladder, or by ſome other meanes to the top of the pike place there your table, couered with paper, ſo as two endes or ſides of the table may be perceiued to hang perpendicularly ouer the horizon, and two other ends or ſides of the ſaid table may

be seene to lye as paralels to the horizon, so that by laying the flat side of your ruler to the said paper, and turning it about close by the paper, you may see thorow the grooue or chanell in the ruler, the bottome of the well in that inside which lieth vnder a part of your table, and is marked in the figure following with B, and likewise the bottome in the opposite inside of the well marked in the said figure with C. This done, draw a perpendicular line vpon the said paper right ouer the inside of the well which lyeth vnder a part of your table, and afterwards putting the fiduciall edge of your ruler to the vpper end of the said perpendicular line, and keeping it there, moue your ruler vp or downe till you haue espied thorow the said grooue or chanel, the bottom in the opposite inside of the well: which done draw a right line by the said fiduciall edge that may point from the vpper end of the said perpendicular line set in an equall heigth with the top of the pike, and marked in the said figure with E, to the bottome in the said opposite inside of the well. Moreouer measure with your instrumēt or wier line from the vpper end of the said perpēdicular line right down towards the base of the pike 10. or 12. feete more or lesse at your pleasure, and hauing made a visible marke vpon the pike at the lower end of the said depth so measured with your instrument or line, open your compasse in the measure of your scale to the number of feete in the said measured depth, and set one foote of the same compasse vnaltred in the vpper end of the said perpendicular line, & with the other foot of the same compasse, make a pricke in the said perpendicular line; which pricke in the said figure is marked with H. When all this is done, take away your table from the top of the pike, and fasten it againe to the pike at the lower ende of the depth so measured with your instrument or line in euery respect as it stood before at the top of the pike, and so as the said pricke may be perceaued to stand in an equall heigth with the said visible marke: and after this putting the fiduciall edge of your ruler to the said pricke, turne it about that pricke till you haue espied againe thorow the said grooue or chanell, the said opposite inside of the well, and then draw by the fiduciall edge of your ruler a right line that may point from the said pricke to the said opposite inside. Now noting diligently where this line last drawne cutteth the other line which at the top of the pike pointed from the vpper ende of the perpendicular line to the said opposite inside, draw from the said intersection marked in the said figure with G a squire line to the said perpendicular line, and open your compasse to the length betwene the vpper end of the said perpendicular line, and that part of the said perpendicular line which is touched with the said squire line, and is marked in the said figure with F, and applying your compasse vnaltered to the diuisions in your scale, say there are so many feete in the depth betweene that part of the pike which was equall in heigth with the vpper end of the said perpendicular line at your first station, and the bottome in the inside of the well vnder a part of your table, as there are diuisions in your scale betweene the two feete

of

of your compaſſe, and that by ſubtracting the height of the vpper end of the ſaid perpendicular line aboue the courbe of the well, from the whole depth laſt meaſured, that is to ſay, from the top of the pike, to B the bottome of the well, the remainer will ſhew the iuſt depth of the ſaid well.

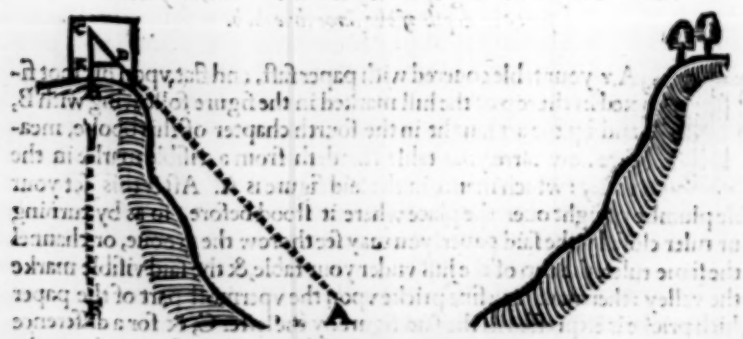


CHAP. XXIIII.

How you ſtanding vpon the top of a hill where is ground enough to go ſidewiſe to the right hand or left hand, may meaſure the depth of the valley vnder the ſame hill, & how you ſtanding vpon the ſide of a drie dich, may meaſure the depth of the ſame drie dich.

LAy your table couered with paper faſt, and flat vpon the foot fixed in the top of the hill marked in the figure following with B, and by the art taught in the fourth chapter of this booke, meaſure how farre your table ſtandeth from a viſible marke in the valley: which marke in the ſaid figure is A. After this ſet your table plumbe vpright ouer the place where it ſtood before, ſo as by turning your ruler cloſe by the ſaid paper, you may ſee thorow the groone, or channel in the ſame ruler, the top of the hill vnder your table, & the ſaid viſible marke in the valley: then making a fine pricke vpon the vpermoſt part of the paper (which pricke is expreſſed in the ſaid figure by the letter C, & for a difference ſhall here be named the firſt pricke) put the fiduciall edge of your ruler to the ſaid pricke, and keeping it there, turne the ruler about the ſame pricke, till you haue eſpied thorow the ſaid groone, or channell, the ſaid viſible marke in the valley: which done, draw by the fiduciall edge of your ruler a right line that may point from the ſaid pricke vnto the ſaid viſible marke. Alſo draw by the fiduciall edge of your ruler from the ſaid pricke, a perpendicular line

downe to the lowest part of the said paper. Now opening your cõpasse in the measure of your scale to the number of feet in the measured distãce betweene the ground on which your table doth stand in the top of the hill, and the said visible marke, set one foote of your compasse vnaltered in the said first pricke, and with the other foote of the compasse, make a second pricke in the right line, which pointeth from the first pricke to the said visible marke: this done draw from this second pricke marked in the said figure with D, a squire line to the said perpendicular line: and after you haue aduisedly noted the crossing of the two lines last named, or (which is here all one) the right angle made with the said two lines last named, & marked in the said figure with E, open your compasse to the length in the line betweene the said right angle, and the first pricke, & applying the same compasse vnaltered to the diuisions in your scale, say there are so many feete in the perpendicular depth betweene the first pricke, and the point of the ground lying within the hill right vnder the said first pricke in an equall depth with the said visible marke, and expressed in the said figure by the letter F, as there are diuisions in your scale betweene the two feete of your compasse, & that by subtracting the heigth of the first prick aboue the ground where your table doth stand, out of the said perpendicular depth before measured, the remainer sheweth the desired depth of the said valley, and that in this manner the depth of any drie dich may be truely measured.

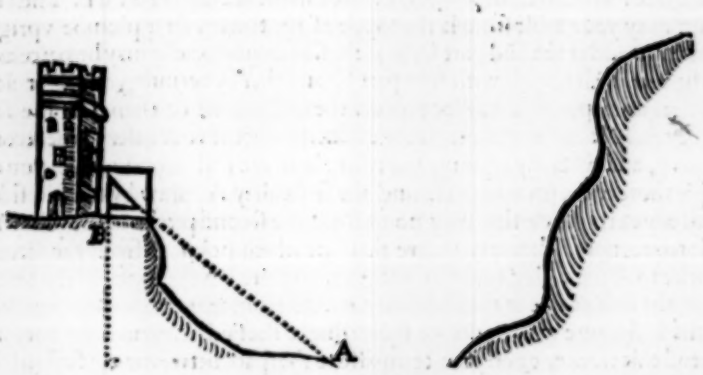


CHAP. XXV.

How you standing in a tower scituated vpon a hill, may measure the depth of a valley lying at the foote of the same hill.

MEASVRE vpon your table by the art taught in the fift chapter of this booke, the distance betweene the base of the tower marked in the figure following

following with B, and a viſible marke in the valley lying at the ſoote of the hill on which the tower is ſcituated: which viſible marke is expreſſed in the ſaid figure by the letter A, and in the reſt of this work ſetting your table at the baſe of the tower, do as you haue bene taught in the 24. chapter of this booke, and by ſo doing you ſhall obtaine your deſire.

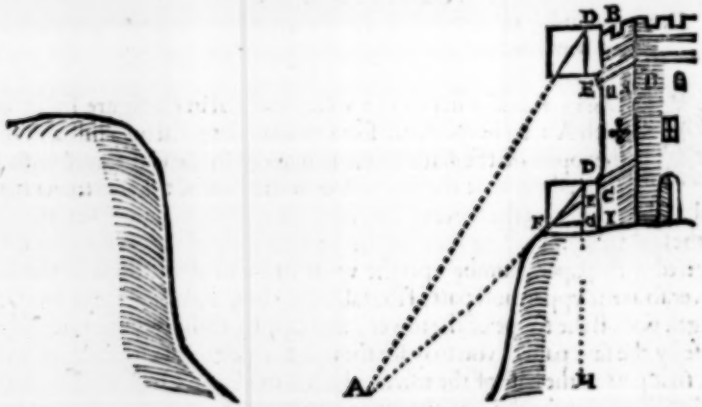


CHAP. XXVI.

How you ſtanding on a tower ſcituated vpon a hill, may meaſure by another way, the depth of a valley at the foote of the ſame hill.

ADMIT that the depth of a valley marked in the figure following with A, is to be meaſured from a tower ſcituated on a hill, and that the toppe of the ſame tower is marked in the ſaid figure with B. Alſo admit that there is a place at the baſe of the ſaid tower marked with C, and that the foote of the ſame hill lieth in an equall heigth with A the ſaid valley. Now to meaſure the depth of the ſaid valley, ſet your table couered with paper plumbe vpright vpon one end in the toppe of the ſaid tower, ſo as the vppermoſt part of the table may be perceiued to lie in an equal heigth with B the toppe of the tower, and that by turning your ruler about cloſe by the ſaid paper, you may ſee thorow the grooue or channell in the ruler, that part of the baſe of the tower which is marked with C, and alſo A the valley. This done make a pricke in the vppermoſt part of the paper, and for a difference name that pricke marked in the figure following with D, the firſt pricke. From this firſt pricke draw downewards a perpendicular line, & putting the fiduciall edge of your ruler cloſe to the firſt pricke, turne the ruler about the pricke, til you may eſpie thorow the ſaid grooue or channel, the valley A, and then draw by the ſaid fiducial edge a right line that may point from

the firſt pricke to A the valley. After this, meaſure with your inſtrument or wyer line the heigth of the ſaid toppe aboue that part at the baſe of the tower which is marked with C, and opening your compaſſe in the meaſure of your ſcale to the number of feete in the meaſured heigth betweene the ſaid toppe, and C, ſet one foote of the compaſſe vnaltred in the firſt pricke, and with the other foote of the ſame compaſſe, make a ſecond pricke in the ſaid perpendicular line: which ſecond pricke is marked in the ſaid figure with E. Then taking away your table from B the toppe of the tower, ſet it plumbe vpright vpon one end at the ſaid part C, ſo as the ſaid ſecond pricke may be perceiued to lie in a leuell heigth with that part C, and that by turning your ruler cloſe by the ſaid paper, you may ſee thorow the ſaid grooue or channell, the ſaid valley A. All this being done, put the fiduciall edge of your ruler to the ſecond pricke, and when by turning the ruler about the ſaid ſecond pricke, you do eſpie thorow the grooue, or channel the ſaid valley A, draw by the ſaid fiduciall edge a right line that may point from the ſecond pricke to the valley A. Moreouer note diligently where this line which pointeth from the ſecond pricke to A the valley, cutteth the line that pointed in the toppe of the tower from the firſt pricke to the ſaid valley A, and from that interſection marked in the ſaid figure with F, draw a ſquire line to the ſaid perpendicular line: and to end this worke, open your compaſſe to the ſpace betweene the firſt pricke and that part of the ſaid perpendicular line which is touched with the ſaid



ſquire line, and marked in the ſaid figure with G, and applying the ſame compaſſe vnaltered to the diuiſions in your ſcale, ſay there are ſo many feete in the depth betweene B the toppe of the tower, and H the foote of the hill, as there are diuiſions in your ſcale betweene the two feete of your compaſſe, and that by ſubtracting the whole heigth of the tower marked in the ſaid figure with

IB, out of the ſaid meaſured depth, the remainer wil ſhew the depth betweene the toppe and foote of the ſaid hill.

The art by which you haue learned before in this book to meaſure depthes doth helpe the ſurueior and land meater to meaſure truely hilles and dales, and moreouer it doth ſhew how deepe the ſuperficies of any valley, ſea, or other water is vnder the toppe of a tower, hill, mountaine, rocke, or any other high place.

CHAP. XXVII.

This chapter ſheweth that the vſe of a drumme, ſtoole, or any other ſmooth ſuperficies differeth not in menſurations and plattes from the vſe of a Geometricall table: Alſo it ſheweth the heigth of the ſteeple in the cathedrall Church of Sarum, the length and bredth of Weſtminſter hall within the cittie of Weſtminſter, the antiquitie of the honorable citie of London, the length & bredth of the cathedral church of S. Paul within the ſaid cittie of London, the heigth of the late ſteeple in the ſaid Church of S. Paul, the diameter, circumference, and concauitie of the guilded ball in the toppe of the ſaid late ſteeple, and the length of the iron croſſe which ſtood vpon the ſaid ball.

NOvv that I haue taught you in this booke to meaſure vppon a table couered with paper, and vpon a drummes head, ſtoole, or any other ſmooth ſuperficies (for the vſe of a drumme, ſtoole, or other ſuperficies in menſurations and plats doth not differ from the vſe of a geometrical table) any meaſurable length, bredth, heigth, or depth, I will alſo declare the heigth of the ſteeple in the cathedrall church of Sarum in Wilſhyre, the length and bredth of Weſtminſter hall builded within the cittie of Weſtminſter in the countie of Middelſex, by king William Rufus the third ſonne of King William the conqueror, about the yeare of our Lord God 1098. the antiquitie of the honorable cittie of London, the length and bredth of the moſt famous church of S. Paul within the ſaid cittie of London, the heigth of the late ſteeple in the ſaid Church of S. Paul, the meaſure of the diameter, circumference, and concauitie of the guilded ball which did lie in the vppermoſt point of the ſaid ſteeple of S. Paul, and the length of the croſſe in the toppe of the ſaid ſteeple of S. Paules church, vntill it was laſt burned which happened by lightning in the fourth day of Iune in anno 1561, and to the end my report of the ſaid famous monuments may be the better beleeued I wiſh this may be knowne, that the ſaid heigthes, lengthes and bredthes are collected out of two regiſter books, of which one appertaineth now to the ſaid Cathedrall church of Sarum, and the other did ſometime belong to the houſe of S. Andrewe in North: and that I haue read of the antiquitie of the citie of London in a torne peece of an old chronicle, which antiquitie is accordingly remembred by M. Doctor *Cunningam* in his coſmographicall glaſſe, and that

the meaſure of the ſaid diameter, circumference, and concauitie, is alſo recorded in the ſaid two regiſters as followeth.

The ſteeple in the cathedrall church of Sarum, is now in height 135. yardes and ½ yarde.

Weſtminſter hall builded by king William Rufus, who (as our Engliſh Cronicles do teſtifie) thought it not bigge enough by one halfe, is in length within the walles 88. yardes and one foote, and in bredth within the walles 24. yardes and one foote.

London the chiefe and principall cittie of all England, was builded (as hiſtories record) before Rome 420. yeares, and before Chriſt our Sauiours incarnation 1136. yeares, and whereas citties through proceſſe of time do come to ruine and decay, this honorable cittie contrariwiſe (praiſed be God) doth more and more beautifie and increaſe.

The cathedrall church of S. Paul within the ſaid honorable cittie of London, is in length 230. yardes (which by reduction make eleuen ſcore & ½ ſcore) and in bredth 43. yardes and one foote.

The late ſteeple of the ſaid cathedrall church of S. Paul within the ſaid honorable cittie of London, was in heigth aboue the ground in the church 178. yardes vntill it was laſt burned: that is to ſay, the ſtoneworke in the ſaid ſteeple was in heigth aboue the ground in the church 86. yards and two foote, and the timberworke which ſtood vpon the toppe of the ſaid ſtoneworke & was couered all ouer with lead, was in heigth 91. yardes and one foote.

The guilded bal which lay faſt in the vppermoſt point of the ſaid late ſteeple in S. Paul his church when it was laſt burned, was in his diameter one yard, in his circumference three yardes and $\frac{1}{11}$ of a yarde, and might in his concauitie haue holden ten buſhels of wheate.

The peece of iron which ſtood vpright in the croſſe aboue the ſaid guilded ball vntill the ſaid late ſteeple was ſo burned, was in heigth fiue yardes, & the peece of iron which did lie ouerthwart in the ſaid croſſe was in length two yards.

CHAP. XXVIII.

How you may draw by angles of poſition the ground plat of any field, manor, cittie, towne, village, caſtle, fort, bulwarke, campe, or region, which ſhall containe the true proportion thereof, how you ought with good conſideration to ſet in your plat one ſtation prick from another, and how it importeth to make a meete or fit ſcale for euerie plat.

WHEN you wil draw the ground plat of a field, go round about the bounds of it once or twiſe, and ſet vpright vpon euerie angle in the ſaid bounds a ſticke of a conuenient length. If the field to be drawne in a plat ſhall haue crooked ſides, or ſides in part right, and in part crooked, erect your ſtickes in the ſaid crooked ſides

somewhat

ſomwhat neare together to make many right ſides in the crooked ſides,which (as it will appeare by the figure following) is an eaſie thing to do. After this couer your table with a cleane white ſheet of paper, as you haue bin taught in the fourth chapter of this booke, & within the field lay your ſaid table flat and faſt vpon his foot in a place from whence you may behold euerie one of the ſaid angles or ſtickes. Then calling the place where the table doth now ſtand, your firſt ſtation, make a fine pricke vpon your paper,and in ſo much as this firſt pricke doth repreſent in your plat the ſaid place of your firſt ſtation, name it the prick of your firſt ſtation. Moreouer put the fiduciall edge at one ende of your ruler to the pricke of your firſt ſtation, turne the other end of the ſaid ruler to or fro, vntill you may ſee thorow the grooue or chanell in the ſaid ruler,one of the ſaid angles or ſtickes:then ſuffering your ruler to lye ſtill, draw with a keeler or cole, by the ſaid fiduciall edge a ſmall line that may point directly from the pricke of your firſt ſtation,vnto the angle or ſticke ſo eſpied, and write vpon the ſame line a letter or figure, to expreſſe that angle. After this putting againe the fiduciall edge at one ende of your ruler to the pricke of your firſt ſtation, turne the other ende of the ruler to or fro,till you may ſee thorow the ſaid grooue or chanell,another of the ſaid angles or ſtickes: which done, ſuffer the ruler to lie ſtill, and draw by the ſaid fiduciall edge another ſmall line that may point from the pricke of your firſt ſtation, vnto the angle or ſticke laſt eſpied,and write vpon the ſame line a different letter or figure to expreſſe the ſaid angle. In like maner drawe by the fiduciall edge of your ruler a right line from the ſaid firſt pricke towards euerie other angle or ſtick in this field,& alſo towards ſome other place within this field where you may againe ſet vp the table, and behold thorow the ſaid grooue or chanell, all the ſaid angles or ſtickes: which place ſhall be named your ſecond ſtation, and muſt of neceſſitie be ſo choſen for to finiſh this plat. When all this is done, write vpon euerie one of thoſe lines a different letter or figure, to expreſſe that angle or ſticke vnto which it pointeth, and leauing a viſible marke in that part of ground which lieth right vnder the prick of your firſt ſtation,meaſure with a wier line, chaine,or cord well ſeared with hot wax and roſen, the diſtance betweene that viſible marke at your firſt ſtation, and the place named your ſecond ſtation, and afterwards opening your compaſſe in the meaſure of your ſcale to the number of pearches found in the meaſured

diſtance, put one foote of your compaſſe vnaltred in the ſaid pricke of your firſt ſtation, and with the other foot of the compaſſe make a ſecond pricke in the line which pointeth from the pricke of your firſt ſtation, vnto the place named your ſecond ſtation, and call this ſecond pricke the pricke of your ſecond ſtation, becauſe it repreſenteth in this plat the ſame place of the field which is named your ſecond ſtation. After all this, carie the table from your firſt ſtation vnto the place of your ſecond ſtatron, and ſet it there in euerie reſpect as it ſtood at your firſt ſtation: that is to ſay, ſet your table there ſo as the pricke of your ſecond ſtation may be perceiued to lie right ouer that point of ground which is called your ſecond ſtation, and that the ſaid firſt pricke may be perceiued to lie directly betweene the ſecond pricke, and the marke at your firſt ſtation. This done, put the fiduciall edge at one ende of your ruler to the ſaid ſecond pricke, moue the other end of the ruler towards euerie one of the ſaid angles or ſtickes which were eſpied through the ſaid grooue or chanell, at your firſt ſtation, and in ſo doing, draw by the ſaid fiduciall edge from this ſecond pricke a ſmall ſtraight line right againſt euerie one of the ſaid angles or ſtickes as you did before at your firſt ſtation from the firſt pricke, and write vpon euerie one of the ſaid lines the ſame letter or figure which was written vpon his like line at your firſt ſtation. After this note aduiſedly where like lines do cut their like (for the interſections in other lines are not here to be regarded) and draw round about your plat from one noted interſection to another, a line like in faſhion to the outſide of the field which it ſheweth: that is to ſay, when the outſide of the field is right, drawe a right line in the outſide of your plat, to ſhew in his due place that right outſide of the field, and when the outſide of the field crooketh outwards, draw in the outſide of your plat a line crooking ſomewhat outwards, to ſhew in his due place that crooked outſide of the field, & when the outſide of the field crooketh inwards, draw in the outſide of your plat a line crooking ſomewhat inwards, to ſhew in his due place the outſide of the field which crooketh inwards. All this being done, wipe away with a feather, or rubbe out with crummes of ſtale bread, all the lines and interſections within your plat, except the lines and interſections which do enuiron the outſides of the deſcribed field, and ſhew the noted angles in the ſaid outſides: and note that as you haue then drawne vppon the face of your table a plat of the ſaid field containing the true forme, and iuſt proportion thereof, you may in the ſame maner by changing your ſtations from one place to another ſcituated in your plat, and going with your table from one field to another, draw a plat of many fields, and ſo not only make a plat of all the fields in a manor or lordſhip, but alſo deſcribe in perfect fourme and true proportion, a whole region with all the cities, townes, villages, pariſhes, caſtles, bulwarkes, forts, camps, ports, gates, riuers, hauens, and all other notable places within the ſame. But in drawing the plat of any place you muſt remember to ſet with good conſideration one ſtation pricke from another, becauſe the concourſe or meeting of

like

like positionall lines, may fall without the compasse of your table when the pricke of the first station is put without aduisement from the pricke of the second station: and likewise you must alwayes beare in mind that for the description of a place, it importeth to make a meete or fit scale, because the longer the measure of a pearch is in your scale, the greater will the plat be.

CHAP. XXIX.

How you may by another way draw by angles of position the ground plat of a wood, or of ane other peece of land, in true forme and iust proportion, how you may plat in his due place an angle which cannot be seene at ane one of your two stations, and how you may plat in his due place an angle which is seene at one of your two stations, and not at the other.

WHEN you will draw the plat of a wood, or any other peece of ground by angles of position, & cannot do it within side thereof for trees, bushes, houses, or other impediments, fixe your table (as you haue bene taught in the 28. chapter of this booke) in the outside of that ground, and afterwards encompassing it round about, and remouing your table from one place or station to another (as you haue also bene instructed in the said 28. chapter) note circumspectly the angles of position at euerie station, & by so doing you shall make an exact plat thereof.

If in drawing the ground plat of any peece of ground by angles of position, a desired place or angle shall lie hidde betweene other angles or obiects, so as you can not see the same at any of your two stations from whence you may see and plat all other angles, or markes round about it, then extend one of the lines which point from the said stations to the obiects lying betweene your sight and the hidden place, and choose immediatly another station at one of the said espied markes, where you may behold the desired angle or place that before could not be seene, and afterwards setting your table there according to my former precepts, draw by the fiduciall edge of your ruler a line that by pointing directly from the prick of this last station to the same angle or place now here espied, shall crosse the said extended line: for the scituation of the said desired place or angle now here espied, is in the said crossing of lines. Likewise whē you may behold a desired place or angle, from one of your two stations, and not from another, by reason of an obiect lying betweene your sight, and the said desired place or angle, it behoooueth you to extend a right line that by pointing from the pricke of one of your said stations vnto the desired place, shall cut his like line (I meane the line which pointed from your other station to the said desired place, or angle) because the scituation of the said desired place, is in the point of that intersection.

CHAP. XXX.

To draw by angles of poſition and diſtances, the ground plat of any vncloſed fielde, walled cittie, towne, caſtell, or fort, in true forme, and iuſt proportion.

SEt vpright (as before you haue bene taught) vpon euerie angle in the bounds of the vncloſed field that ſhalbe deſcribed, a ſtick of a cõuenient length, & laying your table flat & faſt vpon his foote in one of the ſaid angles (which for a difference may here be named the firſt angle and firſt ſtation) make a fine pricke vpon the face of your table right ouer the ſaid firſt angle, and cal it the pricke of your firſt ſtation, becauſe it doth there repreſent the ſaid firſt angle, and firſt ſtation. This done, put the fiduciall edge at one end of your ruler, to the ſaid firſt pricke, and moue the other end of the ruler to or fro, vntill you ſhall eſpie thorow the grooue, or channell in your ruler, the ſticke or angle next before you: which angle ſhall here be called the ſecond angle, and ſecond ſtation. Then ſuffering your ruler to lie ſtill, draw by the ſaid fiduciall edge a line that ſhalbe like in faſhion to the outſide of the field which it ſheweth, and that ſhall point from the firſt angle & firſt ſtation, to the ſaid ſecond angle & ſecõd ſtation. Moreouer meaſure exactly with your wyer line, the diſtance betweene the firſt and ſecond ſtation, and opening your compaſſe in the meaſure of your ſcale to the number of pearches found in that meaſured diſtance, put one foote of the ſame compaſſe vnaltered in the ſaid firſt pricke, and with the other foote make in the ſaid firſt line a ſecond prick, which may repreſent the ſecond angle, and ſecond ſtation. After this take vp your table from the firſt ſtation, and place it by the ſecond angle as it ſtoode by the firſt angle: that is to ſay, ſet the table by the ſecond angle, ſo as the ſaid ſecond pricke may be perceiued to lie right ouer the ſecond angle and ſecond ſtation, and that the ſaid firſt pricke may be perceiued to lie betweene the ſecond pricke, and the ſticke left at the firſt angle and firſt ſtation. This done, put the fiduciall edge at one end of the ruler to the ſaid ſecond pricke, moue the other end of the ruler to or fro, vntill you may eſpie thorow the ſaid grooue or channell, the ſticke in the third angle where you muſt make your third ſtation, and then ſuffering the ruler to lie ſtill, draw by the ſaid fiduciall edge a line that ſhall be like in faſhion to the outſide of the fielde, betweene the ſecond and third angle, and that ſhall point from the ſecond angle and ſecond ſtation, to the third angle and third ſtation. After all this is performed, meaſure with your wier line the ſpace betweene the ſecond ſtation & the third ſtation, & opening your compaſſe in the meaſure of your ſcale to the number of pearches found in the ſaid meaſured ſpace, fixe one foote of the ſame compaſſe vnaltered in the ſaid ſecond pricke, and with the other foote of the compaſſe make a third pricke in the ſecond line that ſhall repreſent the ſaid third angle and third ſtation, and

after-

afterwards tranſporting your table to the third angle and third ſtation, work there as you haue done at either of your two former ſtations: and in the ſame manner proceede vntill by going about this vncloſed field, and by remouing your table from one angle or ſtation to another, you haue made in your plat the pricke of the laſt angle: which done, draw by the fiducial edge of your ruler from the laſt pricke vnto the firſt pricke, a line like in faſhion to the outſide of the field which it ſheweth, & after you haue meaſured with your wier line the diſtance betweene the laſt angle and the firſt angle in this field, open your compaſſe to the length of the line betweene the ſaid pricks, that is to ſay, betweene the laſt pricke, and the firſt pricke, and applying the compaſſe vnaltered to the diuiſions in your ſcale, looke circumſpectly how many of the ſame diuiſions are betweene the two feete of your ſaid compaſſe, for if you haue now drawne a perfect plat of this field, the number of the ſame diuiſions will iuſtly agree with the number of pearches found in the laſt meaſured outſide of the field: I meane the outſide which lieth betweene the laſt angle, and the firſt angle of this open field. Nota.

In this manner by ſetting ſtickes vpright in diuers places vpon a wall that enuironeth a cittie, towne, caſtle, or fort round about, and by working vpon your table at euerie one of the ſaid ſtickes (as before in this chapter you haue bene taught to worke at euerie angle in the deſcribed field) you ſhall draw exactly the ground plat of any walled cittie, towne, caſtle, or fort.

CHAP. XXXI.

To draw after another ſort by angles of poſition and diſtances, the ground plat of any field, or manor, in true forme, and iuſt proportion, and to place a drum ſo as it may be vſed in menſurations, and drawing of plats.

COVER your table with paper (as before you haue bene taught) and hauing ſet ſtickes vpright in euerie angle of the field, lay your table flat, and faſt vpon his foote in ſuch a place within the ſaid field, where you may ſee all the ſaid ſtickes or angles, then making a fine pricke vpon the ſaid paper, call it the firſt pricke, and name the point of ground right vnder the ſaid firſt pricke, the place of your firſt ſtation. After this putting the fiduciall edge at one end of your ruler to the ſaid firſt pricke, moue the other end of the ruler to or fro vntill you may eſpie through the grooue or channell in the ruler, one of the ſaid ſtickes or angles, which for a difference ſhall here be called the firſt ſticke or angle, and then ſuffering the ruler to lie ſtill, draw with a cole, or keeler, by the ſaid fiduciall edge a right line that ſhall point from the ſaid firſt pricke vnto the ſaid firſt ſticke or angle, and write vpon the ſame line a letter or figure to expreſſe that ſticke or angle. This done, put againe the fiduciall edge at one end of your ruler to the ſaid firſt prick, moue the other end of the

ruler to or fro, vntill you may behold through the ſaid grooue or channel, an other of the ſaid ſtickes, which for a difference ſhall here be named the ſecond ſticke or angle, and afterwards ſuffering the ruler to lie ſtill, draw with a cole or keeler, by the ſaid fiduciall edge a right line that ſhall point from the ſaid firſt pricke, vnto the ſaid ſecond ſticke or angle, and write vpon the ſaid line another different letter or figure to expreſſe the ſaid ſecond ſticke or angle. Againe putting the fiduciall edge at one end of your ruler to the ſaid firſt pricke, turne the other end of the ruler (as you did before) to all the reſt of the ſaid ſtickes or angles, and alſo to another conuenient place in the field next adioyning, where you making a ſecond ſtation, may ſet vp your table againe in euerie reſpect as it ſtoode at your firſt ſtation, and behold other ſtickes or angles in the ſaid adioyned fielde, and when in ſo doing you ſhall eſpie thorow the ſaid grooue or channell, any of the ſaid angles or ſtickes, or the place of your ſecond ſtation, draw with a keeler, or cole, by the ſaid fiduciall edge a right line that ſhall point to the angle or place ſo eſpied, and write vpon euerie one of the ſame lines a different letter or figure to expreſſe the angle and place vnto which it pointeth. Now all this being done, meaſure by the art before taught, or with your wier line, chaine, or cord well ſeared with hot waxe and roſen, the diſtance from your firſt ſtation to each of the aforeſaid angles, and alſo to the place appointed for your ſecond ſtation, and then opening your compaſſe in the meaſure of your ſcale to the number of pearches found in the meaſured ſpace betweene your firſt ſtation, and the firſt angle, fixe one foote of the compaſſe vnaltered in the pricke of your firſt ſtation, and with the other foote make an interſection in the line that pointed at your firſt ſtation from the firſt pricke to the firſt angle, and note that the ſaid interſection doth repreſent in this plat the firſt angle of the ſaid field. When you haue placed euerie other noted angle vpon his proper line, as before you haue learned to place the ſaid firſt angle vpon his proper line, draw round about your plat from one interſection to an other, a line like in faſhion to the outſide of the fielde which it ſheweth, and wipe away with a feather or rubbe out with crummes of ſtale bread, all other lines within the plat: that is to ſay, all the ſaid lines which pointed from the pricke of your ſtation, to the angles in the bounds or outſides of the field. All this being done, you haue drawne a plat of this field, and in like maner by changing your ſtations from one place to another ſcituated in your plat, and going out of one field into another, you may draw vpon a geometricall table, or vpon a drummes head, ſtoole, or any other ſmooth ſuperficies a plat of other fields, & deſcribe any manor, or lordſhip, in perfect forme and true proportion: for as I haue told you in the third and 27. chapters of this booke, the vſe of a drumme, ſtoole, or other ſmooth ſuperficies in menſurations, and drawing of plats, will not differ from the vſe of a geometrical table, if where you haue bene required to ſet your table plum vpright vppon one end, you do hang both ends of the drumme in an equall heigth,

heigth,and the face of the ſtoole or other ſuperficies in a perpendicular heigth ouer the horizon, & do ſet the drumme vpright vpon one end,and the ſtoole vpright vpon his feete, where you haue bene aduiſed to place your table flat vpon his foote.

CHAP. XXXII.

How you may make a ſcale for any plat or mappe,how you may reduce many plats into one,and make a faire mappe of all the ground that is in the ſame plats,and how any mappe may be reduced from a bigge forme to a leſſe forme,and from a leſſe forme to a bigge forme,and how it will be needfull for you to write in the ſides or bottome of your mappe,the commodities and diſcommodities of the places which ſhall be there deſcribed.

DRAW vpon a plaine & ſmooth ſuperficies,whether it be boord, plate,or paper, two ſtraight parallel lines of a competēt length, and in a conuenient wideneſſe one from the other : deuide the ſame lines into ſome certaine and like number of equall partes, which ſhal here be named pearches,and may in other menſurations be reckoned for miles,furlongs,ſcores, fathomes, paſes, yards,feet,or inches, and vſe the ſame equall parts for the ſcale of your mappe. Then opening your compaſſe in the meaſure of this ſcale to the diſtance betweene any two angles or places in one of your ſeuerall plats, ſet the compaſſe vnaltred vpon a cleane ſheete of white paper in what part therof you will, and with the two feete of the ſame compaſſe vnaltred , make two fine pricks which ſhall repreſent the ſaid two angles or places in their right diſtance, & write ouer the two prickes of the ſaid places or angles ſo ſcituated, different letters or figures, that they may be knowne from other pricks,which ſhall repreſent in this mappe other angles and places : and here for example let it be ſuppoſed that the two prickes of the ſaid angles or places, are noted with A and B. Nowe for all the other angles and places which muſt be brought into this mappe, this one rule will ſuffiſe. What ſoeuer place it be that you wil next ſet downe in your map, *A generall rule.* ſearch out in the plat containing the ſame place, his diſtance from both thoſe angles or places alreadie ſcituated,and by ſuppoſel noted in your mappe with A and B, and then opening your compaſſe in the meaſure of your ſcale to the number of pearches found in one of the ſaid diſtances(which for example ſhal here be ſuppoſed to be the diſtance betweene the place noted with A, and the angle or place that ſhall be next ſcituated , and for a difference be named the third place) ſtay one foote of your compaſſe vnaltred in the ſaid pricke marked with A, and with the other foot turned vp or downe , draw a circle. This done, open againe your compaſſe in the meaſure of your ſcale to the number of pearches found in the other diſtance (which for example ſhall here be ſuppoſed to be the diſtance betweene the place noted with B, and the ſaid third

place) and fixing one foote of the ſame compaſſe vnaltred in the ſaid pricke marked with B, draw with the other foote another circle, and know that where the ſaid two circles do croſſe or touch one another, there is the true ſituation of the ſaid third place. Thus you may proceed to all the reſt, onely taking heed that hauing opened your compaſſe in the meaſure of your ſcale to the number of pearches found in a diſtance, you fixe the foote of the ſame compaſſe vnaltered in his correſpondent place, and ſo paſſing on from one angle or place to another, you ſhall exactly ſituate in your mappe all the angles and places in the ſaid ſeuerall plats.

An admonition

Note. When two circles drawne for the purpoſe aboue declared ſhall onely touch one the other in a part of their circumferences, draw a right line from the center of one circle, to the center of the other circle, and put the third place (I meane here the place that is next to be ſituated) vpon that interſection which the ſaid right line maketh in the touch of the ſame two circles, but if two circles ſo drawne do croſſe one the other in two ſeuerall places, then by vewing the plat which containeth thoſe three places, and ſeing how they lie there one from the other, you ſhall perceiue in which of the ſame croſſings the ſaid third place muſt be ſcituated. Alſo if this happen by putting the two firſt angles or places vpon the ſaid ſheete of paper in what part thereof you will (as before you haue bene taught to do) that ſome one or diuerſe places which ought to be put within your mappe, wil not be ſcituated vpon the ſaid ſheete of paper, but fall without it, then the remedie is to ioyne faſt with mouth glew, or to paſte to the ſaid ſheete ſo much of other paper, as wil aptly receiue thoſe places which otherwiſe could not haue bene reduced into your ſaid mappe. After you haue reduced all your ſcuerall plats into one mappe, and for to deuide one cloſe from another, haue drawne lines from the pricke of one angle, to the pricke of another angle round about the bounds of ech deſcribed cloſe, you muſt place the ſaid ſcale in his true forme, and equall quantitie, vpon one ſide or end of this mappe where it may beſt, and moſt conueniently ſtand, without diſgrace to any place or peece of ground within the mappe, and then hauing made houſes, trees, and ſuch other like things as ſtand vpon the ground contained in this mappe, where houſes, trees, and ſuch other like things do ſtand, you ſhall in the outſides or edges of your mappe, according as in truth the land within it lieth, write Eaſt, Weſt, South, and North, and waſh your mappe all ouer with diuerſe good and thinne water colours, to ſhew a difference in your mappe betweene meadowes, paſtures, arable land, wood land, hilles, valleies, and grounds belonging to ſundrie tenements and ſeuerall perſons. All this being done the mappe is finiſhed: and note that as by making a leſſer ſcale than the ſcale of this mappe is, and working by the art taught before in this chapter, you may reduce the ſaid mappe into another mappe of a leſſer forme, and like proportion, ſo by making a greater ſcale than the ſcale of this mappe is, and by practiſing that which you

An admonition.

Note.

you haue learned in the ſaid art, you may reduce this mappe into a mappe of a greater forme, and like proportion. Likewiſe you may reduce a map from a bigge forme to a leſſe forme, and from a leſſe forme to a big forme by other certaine rules taught in the ſecond chapter of the third part of *Martin Curtis* booke of Nauigation, vnto which I will here refer you.

An aduiſe by which you may note the cõmodities and diſcommodities of any place.

After you haue in this, or in any other manner, made one mappe of all your ſeuerall plats, it will be needfull for you, eſpecially if you be a ſurueior, land meater, ſouldier, or traueller, to write in the ſides or bottome of the map, the ſorts and ſtore of graine, fruite, vines, flowers, herbes, rootes, graſſe, hay, ſalineſſe or places for making of ſalt, and other profites which the land deſcribed in that mappe yeldeth, the number, flockes, and heards of ſheepe, kine, oxen, ſwine, goates, horſes, mares, and of all other beaſts and cattel which the ſaid land may feede, the ſorts and plentie of wild beaſts, foules, and fiſhes in that land, the names of forreſts, parkes, chaſes, cunnigers, berries and warrens, their largeneſſe, fruitfulneſſe, game, ſcituation, pleaſantneſſe, & to whom they belong, the ſorts and number of timber trees, fruite trees, and of al other trees and plants which growe vpon the ſaid land, the ſcituation of the land, whether it be high land or low land, mountaine or flat, grauelly, chalkie or clay, the quantitie of wood and fewel which the ſaid land beareth, the increaſe and qualities of ſtones, coles, and all other minerall things which may be gotten out of the ſaid land with the yearely value & reuenue of al the ſaid things, the nauie of the king or prince of that place, the number and names of his ſhippes, their formes, burdens, ſtrength, artillerie and imploiment, the multitude of his Pilots, ſhipwrightes, ſhipmaſters, marriners, and others ſkilfull in marine cauſes, the true longitude and latitude of euerie notable place deſcribed, the commodious creekes, bayes, harbors, docks, ports, and hauens of the deſcribed land, their largeneſſe, narrowneſſe, and depth, the ſafeſt and moſt commodious rodes for riding and anchoring of ſhippes in the ſaid deſcribed land, the landing places, ſtaires and wharfes ſeruing to the ſea and hauens in the ſaid deſcribed land, the riſing, ſwelling and falling of the water, the times of ebbing and flowing of the tides in the ſaid deſcribed land, and whatſoeuer elſe that deſcribed land hath ſtrange, new, notable, and commodious. Alſo it will be worth your labour to ſhew in the ſaid writing, whether the beautifull houſes and other notable edifices deſcribed in the ſaid mappe, are builded in a cold, hot, drie, moiſt, or temperat aire, in a fruitfull or barren ſoile, on hilles or rockes, in the deſcents of hilles, or in valleis, neare vnto the ſea, or farre from any nauigable riuer, among running ſtreames of freſh and holſome waters, or where no ſprings of good water may be found, and whether the people there are wittie and of quicke conceite, and whether they liue there long, and come commonly to good ages, or elſe die in their youth or riper yeares: and beſides all this, it will be well liked if you do note the diſpoſition, induſtrie, ſtudies, manners, trades, occupations, honeſtie, humanitie, hoſpitalitie, apparell, and

other morall vertues of the inhabitants of the deſcribed land, and wherein they do excell. Alſo if any cittie, towne, caſtle, or fortreſſe ſhall be deſcribed in your ſaid mappe, it importeth much to note exactly the circuit, bredth, and deepeneſſe of the dich about the ſaid deſcribed place, the ſhalloweſt part of the ſaid dich, the materiall ſtuffe of which the curtaines, bulworks, towers, and gates in the walles of the ſaid deſcribed place are builded, the circuite, heigth, thickneſſe, ſtrength, weakeneſſe, new and old fortifications of euerie curtaine, bulwarke, tower, gate, wharfe and landing place in the ſaid deſcribed place, the number and ſorts of great pieces of artillerie which lie vppon the walles, bulwarks, towers, trenches, rampiers, ſconſes, forts, blockhouſes, and platformes within and about the ſaid deſcribed place, the number of foote men, the number of horſemen, the number of pioners, and the number of inhabitants, which ſerue and dwell in the ſaid deſcribed place, the prerogatiues and priuiledges of the ſaid deſcribed place, the ſubſidies, toulles, impoſtes, and cuſtomes there due and in vſe, the armors and weapons of the ſoldiers in the ſaid deſcribed place, the fortitude, magnanimitie, diſcipline, welth, fame, varietie and manner of warlike watches, orders, marching in battle ray, ſetting of battels, exerciſes, trainings, recreations, paſtimes and behauiors of the ſaid ſoldiars, the prouiſion of victuall, munition, armor, and weapon for the ſaid ſouldiars, pioners, and inhabitants, and the number of horſes or oxen which do draw their artillerie, and ſerue for other needfull things. Moreouer you ſhall deſerue praiſe if you will declare in your ſaid writing, whether the ſaid deſcribed place hath within it any riuers, riuerets, ſprings, or fountaines of freſh and wholſome waters which may be taken away, turned out of their right courſes, infected or poiſoned, whether the bridges belonging to the ſaid deſcribed place are made of timber or ſtone, whether the waies to and fro the ſaid deſcribed place, are large, plaine, ſtraight, faire, quiet, and ſafe, or contrariwiſe narrow, vneuen, crooked, foule, troubleſome, and perilous, whether the victual and munition laid vp in ſtore in the ſaid deſcribed place may there be kept good a long time, and whether the ſaid deſcribed place is by nature, or art ſo ſcituated, as that it cannot be ſcaled with ladders, beaten downe with great ordinance, or vndermined to be blowne vp with gunpouder, for it behoueth a trauailer and alſo a ſouldier that ſhall abide or ſerue in a forraine land to haue a care to returne into his native countrie with more knowledge than he had at his going forth from home.

The end of the firſt booke of LVCARSOLACE.

L'vſo è padre della Sapienza, & la memoria è la madre.

THE SECOND BOOKE OF LVCARSOLACE, CONTAINING PLAINE, CERTAINE AND INFALLIBLE RVLES BY which an ingenious reader may meaſure a right lined diſtance betweene any two places deſcribed in a mappe, tell the circuite and ſuperficiall content of any peece of land deſcribed in a mappe, find the center of anie polygonon equiangle figure, find the center of any circle, make by a part of a circumference the whole circumference agreeing vnto that part, bring any right lined figure into triangles, and know what number of angles in a right lined figure are equall to any certaine number of right angles, in part collected and tranſlated out of diuerſe authors in diuerſe languages, and in part deuiſed by CYPRIAN LVCAR Gent.

CHAP. I.

This Chapter declareth that this ſecond booke ſhall teach the reader to meaſure at home in his chaire by the helpe of his compaſſe and ſcale, any right lined or circular diſtance in a plat or map, to bring any irregular figure into triangles, or into a ſquare or ſquare like figure, and to know the ſuperficiall contents of all ſorts of plaine triangular figures, ſquare, ſquare like and round figures, and alſo of ſome irregular figures.

INSOMVCH as I haue taught you in the firſt booke of this treatiſe to meaſure any right lined length, bredth, heigth, or depth, to draw the plat of any citie, towne, manor, or peece of ground, in true forme, and iuſt proportion, & to reduce many ſeuerall plats into one map, I will not omit to ſhew in this ſecond booke, how you ſitting at home in your chaire, may by the help of your compaſſe and ſcale, tel the right lined or circular diſtãce betweene any two places in a mappe, and know the ſuperficiall content of any mappe or peece of land therein: for which purpoſe if the mappe, plat, or peece of land to be meaſured, ſhall be an irregular figure, or (as ſome writers name it) a Trapezium, I will exhort you to bring all that

irregular figure into ſo few triangles as you may (which by right lines drawne with a fine pointed keeler or cole, from one angle of the ſaid Trapezium, to an other, ſhall eaſily be performed) or to make therof a ſquare, or a ſquare like figure, by ioyning one or more parts to that Trapezium, and then meaſuring euery particular triangle, ſquare, and ſquarelike figure, by the rules following and adding together their ſeuerall contents, note the ſuperficiall meaſure of the whole Trapezium. Through which ſkill and by the art taught in the firſt booke of this treatiſe if bounds and meres of land and ground ſhould be loſt or remoued, or that any perſon by ignorance, negligence, fraude, or violence would wrongfully limite, meaſure, encroch, or challenge by pretence of iuſt content and meaſure, any ground bequeathed, aſſigned, or ſold to another, you may with a plauſible loue and good liking of all good and honeſt men giue vnto euerie man his owne.

I can not denie but that the like rules haue alreadie bene ſet forth in maſter Digges his Engliſh Tectonicon, and Planimetra, in M. Valentine Leigh his engliſh booke named the profitable ſcience of ſuruaying, & in Richard Beneſe his engliſh booke intituled the booke of meaſuring of land, yet conſidering I haue collected my ſaid rules out of *Euclide*, *Iohan. de Monteregio*, *Orontius*, *Sebaſt. Munſterus*, *Petrus Ramus*, *Anton. Maria*, *Coſimo Bartoli*, and *Gio. Franceſco Peuerone*, my truſt is that neither M. Digges, M. Leigh, or any friend of the ſaid dead man Richard Beneſe, will blame me for publiſhing my ſaid collected rules in this engliſh booke, and vppon that truſt will ſet them downe in the chapters following.

CHAP. II.

How you ſitting at home in your chaire, may meaſure any ſide of a figure, any perpendicular line, any right lined diſtance betweene place and place, or the circuite of any manor, citie, campe, or field deſcribed in a mappe.

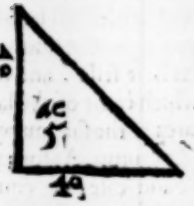
WHEN you ſitting at home in your chaire will meaſure the ſide of any figure, the heigth of a perpendicular line, the length of any right lined diſtance, or the circuite of any place deſcribed in a mappe or plat, open your compaſſe to the length of that line or diſtance which is to be meaſured, & applying the ſame compaſſe vnaltred to the meaſure of your ſcale, ſay there are in that deſired diſtance ſo many pearches, yards, or feet, (according to the denomination of the diuiſions in the meaſure of your ſcale) as you may tell equall diuiſions betweene the two feet of your ſaid compaſſe. Or opening your compaſſe to one of the diuiſions in your ſcale, you may meaſure at home in your chaire with the ſame compaſſe vnaltred the right lined diſtance betweene place and place and the circuite of any manor, citie, campe, or field deſcribed in a mappe, and affirme that in the ſaid meaſured diſtance there are ſo many pearches, yardes, paſes, or feete (according to the denomination of that one diuiſion whereunto you opened your compaſſe) as you haue found in it ſuch diuiſions.

CHAP.

CHAP. III.

To measure the superficiall content of a plat, mappe, or any peece of lande like vnto a right angled or Orthigonium Isosceles: that is to say, a triangle which hath only two sides equall, and one right angle.

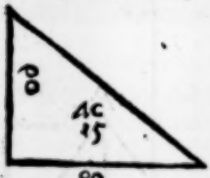
MEasure by the helpe of your compasse and scale (as before you haue bin taught) the length of each equall side in the right angled Isosceles, multiply one of the said lengthes in it selfe, and note the halfe of the product for the area or (which is all one) for the superficiall content of the said right angled Isosceles. As for example let it be supposed that ech equall side of the right angled Isosceles is 40. pearches in length, then multiplying 40. in it selfe, the ofcome will be 1600, & the halfe therof being 800, expresseth the number of pearches in the area of the said right angled Isosceles. Or if you will multiply 40, pearches the whole lēgth of one equal side in the said right angled Isosceles, by 20. pearches the halfe of the other equall side in the said Isosceles, the product thereof yeldeth 800. pearches (which by reduction make 5. statute acars) for the area of the said Isosceles.



CHAP. IIII.

To measure the superficiall content of a plat, mappe, or any peece of land like vnto a right angled or Orthigonium Scalenum: that is to say, a triangle which hath one right angle and all his three sides vnequall.

MEasvre (as you haue bin taught in the second chapter of this second booke) the lengths of the two sides which make a right angle in the Scalenum, multiply the length of one of the said measured lines in the length of the other measured line, & take halfe of the product for the area of the said plat, mappe or peece of land which is like vnto a right angled Scalenum. As for example, if one of the said measured sides be 60. pearches in length, and the other measured side be inelength 80. pearches, multiply 80. pearches by 60. prarches and thereof commeth 4800, & note the halfe of that product, that is to say, note 2400. pearches (which make by reduction 15. statute acars for the area of the said right angled Scalenum. Or multiply the length of one of the said measured lines in halfe the length of the other measured line, and take the product thereof for the area of the said plat, mappe, or peece of land which is like vnto the right angled Scalenum. As for example, multiply 80. pearches the whole length of one of the said measured lines by 30. pearches the halfe of the length in the other mea-



ſured line and take the product thereof, that is to ſay, 2400. pearches (which make by reduction 15. ſtatute acars) as before I told you for the area of the ſaid right angled Scalenum.

CHAP. V.

How there are three diuerſe ſortes of acute angled triangles, how the area of an equilater Oxigonium may be meaſured, how the length of a perpendicular line in an equilater Oxigonium may be knowne, and how the length of each equall ſide in an equilater Oxigonium may be found.

To meaſure the area of an equilater oxigonium.

THere are three diuers ſorts of acute angled triangles, that is to ſay, Equilater oxigonium, Iſoſceles oxigonium, and Scalenum oxigonium, and they are meaſured by diuers waies: wherefore when a map, plat, or peece of land to be meaſured, ſhall be like vnto an equilater oxigonium, you may multiplie the knowne length of one equall ſide of the ſaid equilater oxigonium in it ſelfe, and the product thereof in 13. and then diuiding the number which came of the laſt multiplication by 30. note the quotient number for the area of the ſaid mappe plat, or peece of land in faſhion like vnto an Equilater oxigonium. As for example, admitting that you haue found by your compaſſe and ſcale each equal ſide of the equilater oxigonium to be 20. pearches in length, you ſhall firſt multiplie 20. in 20. and thereof commeth 400. then you ſhall multiplie this 400. by 13. and the product thereof will be 5200. and laſt of all diuiding the ſaid number of 5200. by 30. you ſhall finde in the quotient 173. pearches and $\frac{1}{3}$ of a pearch (which make by reduction one acar, three day works, one pearch, and $\frac{1}{3}$ of a pearch) for the area of the equilater oxigonium. Alſo you may meaſure an equilater oxigonium by the altitude thereof, or (which is al one thing) by the length of a perpendicular line drawne from the angle in the toppe of the equilater oxigonium, vnto the middle part of the baſe of the ſame equilater oxigonium, as the line *a d* is drawne in the equilater oxigonium here depicted. And if you will multiplie one of the equall ſides of the equilater oxigonium by 13. and diuide the product therof by 15. the quotient number will ſhew vnto you the deſired length of the ſaid perpendicular line. As for example, multiplie 20. pearches the length of one of the ſaid equall ſides by 13. and the product thereof will be 260. diuide this number of 260. by 15. and the quotient number (which is 17. pearches and $\frac{1}{3}$ of a pearch) ſheweth the iuſt altitude of the ſaid equilater oxigonium, and the true length of the ſaid perpendicular line. Or by opening your compaſſe to the ſhorteſt extenſion or ſpace that is betweene the angle in the toppe of any oxigonium what-

To finde the length of a perpendicular line which you may meaſure eaſily the altitude of an Equilater oxigonium.

whatſoeuer, and the baſe of the ſaid oxigonium, and applying the ſame compaſſe vnaltered to the meaſure in your ſcale, you may ſay, that there are ſo many pearches and parts of a pearch in the length of the deſired perpendicular line as you may tell equall diuiſions, and parts of one diuiſion, betweene the two feete of your vnaltered compaſſe. Now the ſaid perpendicular line being found by any of the ſaid two waies or otherwiſe, meaſure the area of the equilater oxigonium thus. Multiplie the length of the ſaid perpendicular line in halfe the length of the baſe or equall ſide on which it falleth, and note the product thereof for the area of the ſaid equilater oxigonium. As for example, multiplie 17. pearches and $\frac{1}{3}$ of a pearch (the length of the perpendicular line) by tenne pearches the halfe of the length in the baſe or equall ſide on which it falleth, and thereof commeth 173. pearches and $\frac{1}{3}$ of a pearch (making by reduction one acar, three day workes, one pearch, and $\frac{1}{3}$ of a pearch) the area of the ſaid equilater oxigonium.

An other way by which you may finde the length of a perpendicular line in any oxigonium whatſoeuer.

To meaſure the area of an Equilater oxigonium by the helpe of a perpendicular line.

Alſo by knowing the length of the perpendicular line in an equilater oxigonium, and by the art of numbring, you may tell the iuſt length of ech equal ſide in the ſaid equilater oxigonium: for if you will multiplie the knowne length of a perpendicular line in an equilater oxigonium by 15. and diuide the product thereof by 13. the quotient number will ſhew the iuſt length of each equall ſide in the ſaid equilater oxigonium. As for example, multiplie 17. pearches and $\frac{1}{3}$ of a pearch (the length of the perpendicular line) by 15. and thereof commeth 260. which diuided by 13. yeeldeth in the quotient 20. pearches for the iuſt length of ech equall ſide in the ſaid equilater oxigonium. Likewiſe by knowing the area of an equilater oxigonium, and by the art of numbring, you may tell the iuſt length of ech equall ſide in the ſaid equilater oxigonium, and to do ſo, multiplie the area of the equilater oxigonium by 30. diuide the product thereof by 13. out of the quotient number extract the ſquare roote, and note that ſquare roote for the true length of each equall ſide in the ſaid equilater oxigonium. As for example admitting the area of the equilater oxigonium to be 173. pearches and $\frac{1}{3}$, multiplie the ſaid number of 173. and $\frac{1}{3}$ by 30. and the product thereof will be $5190\frac{1}{3}$ diuide this number of $5190\frac{1}{3}$ by 13, out of the quotient number thereof (which in integers wil be 400) extract the ſquare roote which is 20. and note the number of 20. in the ſaid ſquare roote, for the true number of pearches in each equall ſide of the ſaid equilater oxigonium.

To tel the length of ech equall ſide in an Equilater oxigonium by the helpe of a perpendicular line and the art of numbring.

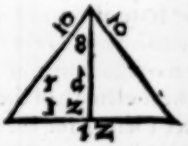
To tel the length of each Equilater oxigonium by the area of the ſaid Equilater oxigonium and by the art of numbring.

CHAP. VI.

How you may by two wayes finde the length of a perpendicular line which will helpe you to meaſure the area of any peece of land like in faſhion to an Iſoſceles oxigonium, and how the area of any peece of land like in faſhion to an Iſoſceles oxigonium, may by the helpe of the ſaid perpendicular line be exactly meaſured.

TO knowe the iuſt length of a perpendicular line which wil helpe you to meaſure the area of a peece of land like in faſhion to an Iſoſceles oxigoniū

here depicted, ſearch out with your compaſſe & ſcale (as you haue bene taught) the length of the ſaid perpendicular line, or multiply half the length of the baſe of the ſaid Iſoſceles oxigonium in it ſelfe, and reſerue the product thereof. Alſo multiplie the length of one equall ſide of the ſaid Iſoſceles oxigoniū in it ſelfe, and out of the ſumme which riſeth therof, ſubtract the ſaid reſerued product, & out of the remainer, extract the ſquare roote which will ſhew the length of the deſired perpendicular line. As for example admitting that each equall ſide of the ſaid Iſoſceles oxigonium to be meaſured is 10. pearches in length, and that the vnequall ſide or baſe thereof is 12. pearches in length, multiplie 6. pearches the halfe of the length of the ſaid baſe in it ſelfe, and the product therof wil be 36. pearches: alſo multiplie 10. pearches the length of one of the ſaid equall ſides in it ſelfe, and the ofcome will be 100. pearches, then ſubtract the ſaid 36. pearches out of the ſaid 100. pearches, and ſo 64. pearches wil remaine. After this extract the ſquare root of 64, and note that ſquare root which is 8. for the number of pearches in the length of the ſaid perpendicular line.



The length of the ſaid perpēdicular line being by any of the ſaid two waies or otherwiſe knowne, multiply the ſame length (I meane the length of the ſaid perpendicular line) in halfe the length of the baſe or ſide on which it falleth, and note the product for the area of the ſaid peece of land like in faſhion to an Iſoſceles oxigonium. As for example admitting the ſaid perpendicular line to be 8. pearches in length, and the baſe on which it falleth to be 12. pearches in length, multiplie 8. in the halfe of 12. that is to ſay in 6. & the product therof will be 48. pearches, making by reduction one roode, and two dayworkes, the area of the ſaid peece of land like in faſhion to an Iſoſceles oxigonium.

CHAP. VII.

How you may by three ſundrie wayes find the length of the perpendicular line which will helpe you to meaſure the area of a peece of land like in faſhion to an oxigonum ſcalenum, and how the area of a peece of land like in faſhion to an oxigonum ſcalenum may by the helpe of the ſaid perpendicular line be exactly meaſured.

THE length of the perpendicular line which will help you to meaſure the area of a peece of land like in faſhion to the oxigonium ſcalenum here depicted, (that is to ſay, like vnto this depicted triangle A B C which hath all his three angles acute, and no ſide equall to other) may by your compaſſe and ſcale be thus found. Open your com-

paſſe

paſſe to the ſhorteſt extenſion betweene A the angle in the top of the ſaid triangle, and B C the baſe of the ſame triangle,& then applying your compaſſe vnaltred to the meaſure of your ſcale, you may boldly affirme that there are ſo many pearches, and parts of a pearch, in the length of the deſired perpendicular line, as you may tell equall diuiſions, and parts of one diuiſion, betweene the two feete of the ſaid vnaltred compaſſe. Alſo you may finde the length of the ſaid perpendicular line by this meanes. Multiplie the baſe and euerie other ſide of the ſaid triangle in it ſelfe, and reſerue their productes. This done adde togither the ſquare of the baſe and the ſquare of the ſide of the ſaid triangle which is here marked with A C, and out of the ſum that commeth thereof, abate the ſquare of the other ſide of the ſaid triangle which is here marked with A B, and by halfe of the remainer, diuide the length of the ſaid baſe B C, and take the quotient number for the length of that part of the baſe which in the ſaid triangle is betweene the angle C and the point D, vpon which the ſaid perpendicular line muſt fall. After all this, multiplie the length of that part of the baſe which is here marked with D C in it ſelfe, ſubtract the ſumme amounting thereof from the ſaid reſerued product of the ſide A C, and note the ſquare roote of the remainer for the true length of the ſaid perpendicular line. As for example admitting that the land to be meaſured is like vnto the oxigonium ſcalenũ here depicted & marked with A B D C, & that A C one ſide thereof is in length 13. pearches, A B the other ſide is in length 15. pearches and B D C the baſe is in length 14. pearches: multiplie 13. pearches the length of the ſide A C by 13. and reſerue the product thereof, which maketh 169. pearches. Likewiſe multiplie 15. pearches the length of the ſaid ſide A B by 15. and reſerue the ofcome which maketh 225. pearches. Alſo multiplie 14. pearches the length of the ſaid baſe B D C by 14. and reſerue the product which maketh 196 pearches. This done put the reſerued product of the ſide A C vnto the reſerued product of the baſe, and out of the ſumme thereof amounting, that is to ſay, out of 365. ſubtract 225. the ſquare of the ſaid ſide A B, and then diuiding halfe of the remainer, that is to ſay, diuiding 70 by 14. pearches the length of the ſaid baſe B C, take the quotient number which yeldeth 5. pearches for the length of that part of the baſe which is in the aforeſaid triangle betweene the ſaid angle C, and the ſaid point D, on which the perpendicular line muſt fall. All this being done multiply fiue the length of the ſaid part of the baſe which is here marked with D C, by 5. and abate the product thereof which is 25. from 169. the reſerued product of the ſaid ſide A C and out of 144 the remainer, extract the ſquare which is 12. the iuſt number of pearches in the deſired length of the ſaid perpendicular line. Moreouer you may ſearch out the length of the ſaid perpendicular line in this manner. Square the length of the ſaid baſe, alſo ſquare the length of the ſaid ſide A B, and adde their ſquares togither, and out of the ſumme thereof amounting, ſubtract the ſquare of the length in the ſaid ſide A C, and diuide halfe of the remainer by the length of

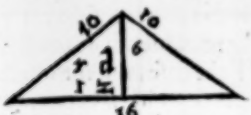
the baſe, and ſo the quotient will ſhew the true length of that part of the ſaid baſe which in the ſaid triangle is betweene the angle B, and the ſaid point D, on which the perpendicular line muſt fall. After all this is done, ſquare the length of the ſaid part of the baſe marked here with B D,& out of that ſquare, abate the ſquare of the length in the ſaid ſide A B, and note the ſquare roote of the remainer for the iuſt length of the ſaid perpendicular line. As for example put 196. the ſquare of the length in the ſaid baſe to 225. the ſquare of the length in the ſaid ſide A B, and thereof commeth 421. out of that number of 421. abate 169. the ſquare of the ſaid ſide A C, and diuide halfe of the remainer, that is to ſay, diuide 126. by 14. the length of the ſaid baſe, and ſo the quotient yeeldeth 9. pearches for the length of that part of the baſe which in the ſaid triangle is betweene the angle B, and the point D on which the perpendicular line muſt fall. This done, ſquare 9. pearches the length of the ſaid part of the baſe which is here marked with B D, and there riſeth 81. ſubtract this number 81. out of 225. the ſquare of the length in the ſaid ſide A B, and there remaineth 144. and then extract the ſquare roote of 144. which being 12. ſheweth the number of pearches in the deſired length of the ſaid perpendicular line. After you haue ſearched out in this manner, or by any other meanes, the length of the ſaid perpendicular line, multiplie the ſaid length in halfe the length of the baſe on which it doth fall, and note the product thereof for the area of the ſaid peece of land like in faſhion to an oxigonium ſcalenum. As for example, multiplie 12. pearches the length of the ſaid perpendicular line by 7. pearches the halfe of the length of the ſaid baſe, and the ofcome will be 84. pearches (which by reduction make two rood, and one dayworke) the area of the ſaid peece of land like in faſhion to an oxigonium ſcalenum.

CHAP. VIII.

How there are two kindes of obtuſeangled triangles, that is to ſay, there is an ambligonium Iſoceles, and an ambligonium ſcalenum: and how you may know the area of a peece of land like in faſhion to an ambligonium Iſoceles.

THERE are two kinds of obtuſeangled triangles, videlicet ambligonium Iſoceles, and ambligonium ſcalenum, wherefore to meaſure a peece of land like in faſhion to an ambligonium Iſoceles, ſearch out (as you haue bene taught in the 6. chapter of this booke) the length of the perpendicular line which will help you to meaſure the ſuperficiall content or area of the ſaid peece of land, and that being done, multiplie the length of the ſaid perpendicular line in halfe the length of the baſe on which it falleth, and note the product thereof for the area of the ſaid peece of land. As for example, admitting that each of the

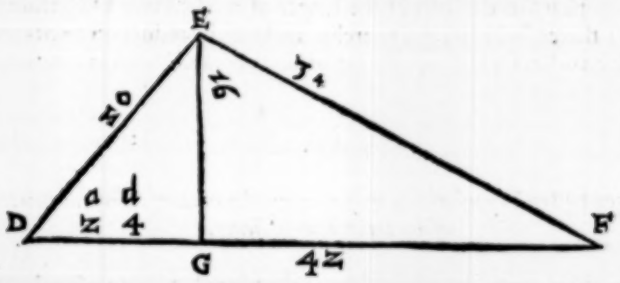
the two equall ſides of the ſaid peece of land is in length 10. pearches, and that the ſaid baſe is in length 16. pearches, ſquare 10. the length of one of the ſaid equall ſides, and there riſeth 100. Moreouer ſquare 8. the halfe of the length in the baſe, and the ſumme comming thereof will be 64. then ſubtract the ſaid number of 64. out of 100. the other number, and there commeth 36. and take the ſquare roote of 36. which is 6. for the iuſt length of the deſired perpendicular line. Al this being done, multiply 6. pearches the length of the ſaid perpendicular line, in 8. pearches the halfe of the length in the ſaid baſe, and note the product thereof which is 48. pearches, making by reduction one roode, and two dayworks, for the area of the ſaid peece of land like in faſhion to an ambligonium Iſoſceles.



CHAP. IX.

How you may know by three diuers waues the length of the perpendicular line which will helpe you to meaſure the area of a peece of land like in faſhion to an ambligonium ſcalenum, and how the area of a peece of land like in faſhion to an ambligonium ſcalenum may be meaſured.

THe iuſt length of the perpendicular line which will helpe you to meaſure the area of a peece of land like in faſhion to the ambligonium ſcalenum here depicted, and marked with D E F G, may be knowne by your compaſſe and ſcale, & alſo by the art of numbring, as in the ſeuenth chapter of this ſecond booke, the length of a perpendicular line in an oxigonium ſcalenum was knowne. Therfore admitting that the ſide D E of this ambligonium ſcalenum is in length



20. pearches, E F another ſide of the ſaid ambligonium ſcalenum is in length 34. pearches, and that D F the baſe of the ſaid ambligonium ſcalenum is in

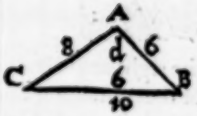
length 42. pearches, multiplie 20. pearches the length of D E in 20. and the ofcome will be 400. Likewiſe multiplie 34. pearches the length of E F by 34. and thereof commeth 1156. Alſo multiplie 42. pearches the length of D F by 42. and the product will be 1764. this done adde togither the ſaid products 1156. and 1764. and there riſeth 2920. from that number of 2920. ſubtract 400. and there will remaine 2520. Diuide the halfe of the remainer, that is to ſay, diuide 1260. the halfe of 2520. by 42. the length of D F the baſe, and the quotient which is 30. will ſhew the length of that part of the baſe which is betweene the angle F, and G a point in the ſaid baſe on which the ſaid perpendicular line muſt fall. All this being done, multiplie the ſaid number of 30. in it ſelfe, and the product thereof will be 900. ſubtract that ſumme of 900. out of 1156. the ſquare of the ſaid number 34. & there reſteth 256. and then note 16. the ſquare roote of the ſaid remainer 256. for the number of pearches in the deſired length of the ſaid perpendicular line. Alſo the length of the ſaid perpendicular line may be thus found. Adde 400. the ſquare of 20. the length of the ſaid ſide D E, vnto 1764. the ſquare of 42. the length of the ſaid baſe D F, and the ofcome will be 2164. ſubtract 1156. the ſquare of 34. the length of the ſaid ſide E F, out of that ſumme of 2164. and the remainer will be 1008. Diuide the halfe of 1008. that is to ſay, diuide 504. by 42. pearches the length of the ſaid baſe, & note the quotient which is 12. for the number of pearches in the length of that part of the baſe which is betweene the angle D, and the ſaid G, a point in the ſaid baſe, on which the perpendicular line muſt fall. When all this is done, multiplie the ſaid number of 12. in it ſelfe and the product thereof will be 144. ſubtract the ſaid ſumme of 144. out of 400. the ſquare of 20. the length of the ſaid ſide D E, and there reſteth 256. and then take 16. the ſquare roote of the ſaid remainer 256. for the deſired length of the ſaid perpendicular line. After you haue by any of the ſaid three wayes ſearched out the exact length of the perpendicular line, multiplie that laſt named length, videlizet 16. pearches, in 21. pearches the halfe of the length of the ſaid baſe D F, and take the product thereof which is 336. pearches making by reduction two acars, and foure dayworkes, for the area of the ſaid peece of land like in faſhion to an ambligonium ſcalenum.

CHAP. X.

A generall rule by which you may meaſure the area or ſuperficiall content of any triangle whatſoeuer.

ADde together all the ſides of the triangle to be meaſured, out of the halfe of the number which ſurmounteth, ſubtract euerie ſide by it ſelfe, and note how much euerie ſide differeth from that halfe: then multiplie that halfe by any one which you wil of the ſaid differences

ces: moreouer multiplie the product therof by another which you will of the ſaid differences, and multiplie the ofcome thereof by the third and laſt difference, and out of the ſumme that will riſe thereby, extract the ſquare roote which yeldeth the deſired area of the ſaid triangle. As for example admitting that the triangle to be meaſured is A B C, and that A B the right ſide therof is 6. pearches in length, & that A C the left ſide is 8. pearches in length, and that C B the baſe is 10. pearches in length, adde together all the lengthes in the ſaid ſides and baſe, that is to ſay adde together the ſaid 10. 8. & 6. which make 24. and out of the halfe thereof, that is to ſay, out of 12. abate 6, and there reſteth 6 which is one of the differences to be noted. Moreouer ſubtract 8. out of 12. and there remaineth 4. another difference to be noted. Alſo abate 10. out of 12, and there will remaine 2 which is the laſt difference to be noted. After this multiplie the ſaid number of 12. by 6. one of the ſaid differences, and there will come 72. Moreouer multiplie the ſaid product of 72. by 4 another of the ſaid differences, & there will amount 288. Alſo multiplie the ſaid product of 288. by 2. the laſt named difference, & therby will ariſe 576. out of the ſaid product, that is to ſay, out of 576 extract the ſquare roote which is 24, and take that ſquare roote videlicet 24. pearches making by reduction ſixe day workes, for the area of the ſaide triangle.

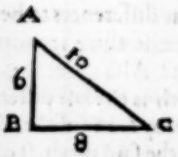


If you will multiplie the ſaid number of 12. by the ſaid difference of 4, and the product thereof by the ſaid difference of 6, and the product thereof by the ſaid difference of 2, or if you will multiplie the ſaid number of 12. by the ſaid difference of 2, and the product thereof by the ſaid difference of 4, and the product therof by the ſaid difference of 6: or if you will multiplie the ſaid number of 12. by the ſaid difference of 2, and the product therof by the ſaid difference of 6, and the product therof by the ſaid difference of 4; you ſhall find in the laſt product the ſaid number 576. which yeeldeth for his ſquare roote 24. the number of pearches in the area of the ſaid triangle A B C. Likewiſe if you wil multiplie the ſaid difference of 6. by the ſaid difference of 4, & the product therof by the ſaid difference of 2, and the product therof by the ſaid number of 12. Or if you will multiplie the ſaid difference of 6. by the ſaid difference of 2, and the product therof by the ſaid difference of 4, and the product thereof by the ſaid number of 12. Or if you will multiplie the ſaid difference of 4. by the ſaid difference of 2, and the product therof by the ſaid difference of 6, and the product therof by the ſaid number of 12. you ſhal find in the laſt product the ſaid number 576. which yeeldeth (as before I haue told you) for his ſquare roote 24, the nūber of pearches in the area or ſuperficiall content of the ſaid triangle A B C.

CHAP. XI.

How you by knowing any two ſides of a right angled triangle may tell the third ſide.

WHEN you knowing the two ſides which containe the right angle will ſearch out the vnknowne third ſide, that is to ſay the hipothenuſa, adde together the ſquares of the ſaid two containing ſides, and note the ſquare roote of the ofcome for the deſired length of the hipothenuſa. As for example admitting in A B C the right angled triangle here depicted, that A B one of the containing ſides is knowne to be 6. pearches in length, & that B C the other containing ſide is known to be 8 pearches in length, and that you deſire to know the vnknown length of A C the hipothenuſa, you ſhal ſquare 6. and therof will come 36. Alſo you ſhall ſquare 8. and the product thereof will be 64, and when you haue ſo done, you ſhall ad together both thoſe ſquares: that is to ſay 36. and 64. which make 100: and note 10. pearches the ſquare roote of that 100. for the iuſt length of the ſaid hipothenuſa A C. But if you knowing the length of the hipothenuſa, and the length of one of the containing ſides in a right angled triangle, will ſearch out the vnknowne length of the other containing ſide in the ſaid right angled triangle, ſquare the known length of the hipothenuſa, & ſquare alſo the knowne length of the containing ſide, and then ſubtract one of thoſe ſquares from the other, and note the ſquare root of the remainer for the vnknowne length which you deſired to find. As for example admit that you knowing the length of A C the hipothenuſa to be 10. pearches, and the length of B C one of the containing ſides to be 8. pearches, will ſearch out the vnknowne length of A B the other containing ſide, you ſhal ſubtract 64. the ſquare of the knowne length in B C from 100. the ſquare of the knowne length in A C the hipothenuſa, and note 6. pearches the ſquare roote of 36. the remainer for the deſired length of the ſaid ſide A B.



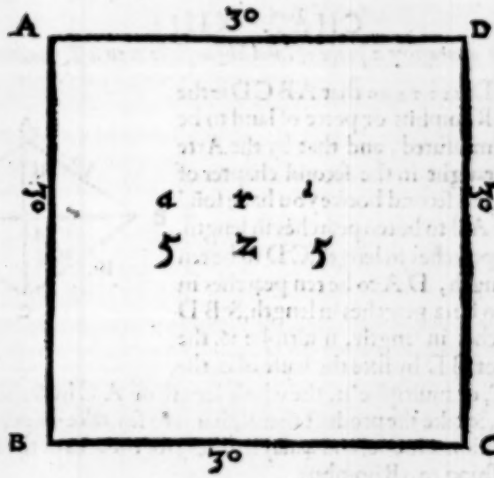
CHAP. XII.

To meaſure a ſquare peece of land.

MVLTIPLIE the knowne length of one ſide of the ſquare peece of land in it ſelfe, and take the product for the area of the ſaid ſquare peece of land. As for example admitting that A B C D is a ſquare peece of land to be meaſured, and that euery ſide of it is in length 30. pearches, multiplie 30. one of the ſaid equall ſides in

in it ſelfe, and take the product therof which is 900. pearches making by redu-

The angles of euery quadrigled figure are equall to foure right angles because it may be brought into 2. triangles, and that the 3. angles of euery triangle are equall to two right angles.

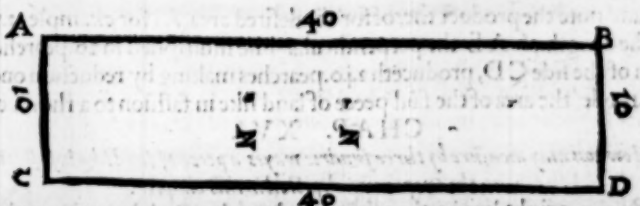


ction 5. acars, 2. roode, and 5. dayworks, for the area of A B C D the ſaid ſquare peece of land.

CHAP. XIII.

To meaſure a ſquarelike or long ſquare peece of land.

AFTER you haue meaſured two vnequall ſides of a ſquarelike or long ſquare peece of land, multiplie one of thoſe ſides in the other, & note the ofcome for the area of the ſaid ſquarelike peece of land. As for example admitting that A B C D is a ſquarelike peece of land to be



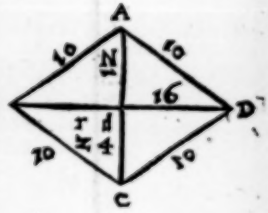
meaſured, and that A B one ſide therof is 40. pearches in length, and that A C

another ſide therof is 10. pearches in length, multiplie 40. pearches by 10. pearches, and take the product therof, that is to ſay, take 400. pearches making by reduction 2. acars, and 2. roode, for the area of A B C D the ſaid ſquarelike peece of land.

CHAP. XIIII.

To meaſure a peece of land like in faſhion to a Rhombus.

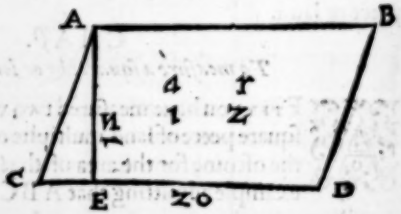
DMITTING that A B C D is the Rhombus or peece of land to be meaſured, and that by the Arte taught in the ſecond chapter of this ſecond booke you haue foūd A B to be ten pearches in length, B C to be ten pearches in length, C D to be ten pearches in length, D A to be ten pearches in length, A C to be 12. pearches in length, & B D to be 16. pearches in length, multiplie 16. the whole length of B D by ſixe the halfe of 12. the length of A C, or multiplie 12. the whole length of A C by 8. the halfe of the length of B D, & take the product therof, that is to ſay, take 96. pearches which make by reduction 2. roode, and 4. dayworkes, for the area of the ſaid peece of land like in faſhion to a Rhombus.



CHAP. XV.

To meaſure a peece of land like in faſhion to a rhomboides.

A B C D is by imagination a rhomboides or peece of land to be meaſured, and the area therof may be known if you wil multiplie the length of the perpendicular line A E, in the length of the ſide on which it falleth, that is to ſay, in the length of the ſide C D, and note the product therof for the deſired area. As for example, 12. pearches the length of A E the perpendicular line multiplied in 20. pearches the length of the ſide C D, produceth 240. pearches making by reduction one acar and 2. roode, the area of the ſaid peece of land like in faſhion to a rhomboides.

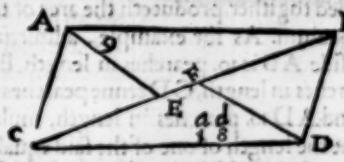


CHAP. XVI.

How you may meaſure by three ſundrie wayes a peece of land like in faſhion to the trapezium depicted in this chapter.

DRAWE a right line in the trapezium here depicted from the angle C to the angle B. Alſo drawe a perpendicular line from the angle A to the point

point E in the ſaid right line, and laſt of all draw a perpendicular line from the angle D to the point F in the ſaid right line. This done meaſure (as you haue bene taught in the ſecond chapter of this ſecond booke) the length of the ſaid right line, the length of the perpendicular A E, and the length of the perpendicular D F, and afterwards adde togither the lengthes of thoſe two perpendiculars, and multiplie the halfe of that which riſeth thereby in the whole length of the ſaid right line: or multiplie the halfe of the ſaid right line in the lengthes of thoſe two perpendiculars, and take the oſcome for the area of the ſaid trapezium. As for example admitting that the ſaid right line is in length 24. pearches, & that the perpendicular line A E is in length nine pearches, and that the perpendicular line D F is in length ſeuen pearches, adde togither nine and ſeuen which make 16. and multiplie the halfe of 16. which is 8. in 24. and note the product therof, that is to ſay, note 192. pearches which make by reduction one acar, and 8. dayworks for the area of the ſaid trapezium. Or multiply 16. the lengthes of the ſaid two perpendiculars by 12. the halfe of the length of the ſaid right line, and thereof will riſe 192. pearches which by reduction make one acar, & 8. dayworks, the area of the ſaid peece of land like in faſhion to the trapezium depicted in this chapter. Alſo if you will meaſure by the art taught in the tenth chapter of this ſecond booke, the ſuperficiall contents of the two triangles in the ſaid trapezium (for by a right line drawne from the angle A to the angle D, or from the angle C to the angle B, the ſaid trapezium is brought into two triangles) and will adde togither the ſuperficiall contents of the ſaid two triangles, you ſhall know the area of the ſaid trapezium.

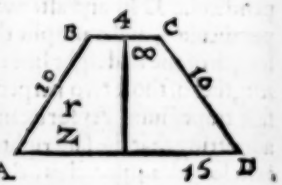


CHAP. XVII.

How you may by two diuers wayes ſearch out the length of the perpendicular line which will helpe you to meaſure a peece of land like in faſhion to the trapezium depicted in this 17. chapter, and how you may meaſure the area or ſuperficiall content of a peece of land like in faſhion vnto the ſaid trapezium.

IF a peece of land to be meaſured ſhall in faſhion be like vnto A B C D the trapezium here depicted, meaſure (as you haue bene taught in the ſecond chapt. of this ſecond booke) the length of the ſide A B, the length of B C in the toppe, the length of the ſide C D, and the length of the baſe D A. This done, multiplie the ſaid ſide A B, or the ſaid ſide C D in it ſelf, & reſerue the product. After this abate the ſaid length of B C from the length A D, ſquare

halfe of the remainer, and ſubtracting the ſame ſquare from the ſaid reſerued product, note the ſquare roote of the remainer for the length of the perpendicular line which will helpe you to meaſure the area of the ſaid trapezium. Alſo you may by the art taught in the ſaid ſecond chapter of this ſecond booke ſearch out the exact length of the ſaid perpendicular line, which multipled in halfe of the ſaid lengthes B C and A D added togither, produceth the area of the ſaid trapezium. As for example, admitting that the ſide A B is 10. pearches in length, B C four pearches in length, C D tenne pearches in length, and A D 16. pearches in length, multiplie tenne the length of one of the ſaid equall ſides in it ſelfe, and there riſeth 100. to be reſerued, after this abate 4. the length of B C the toppe from 16. the length of A D the baſe, and the remainer will be 12. then ſquare 6. the halfe of that remainer, and the ſquare thereof will be 36. ſubtract the ſaid ſquare (I meane 36.) from 100. before reſerued, & there remaineth 64. extract the ſquare roote of 64. the ſaid remainer, and take that ſquare roote which is 8. pearches for the deſired length of the perpendicular line which will helpe you to meaſure the ſuperficiall content of the ſaid trapezium. The length of this perpendicular line being thus by the art of numbring, or by the art taught in the ſaid ſecond chapter of this ſecond book found, adde 4. the length of B C the toppe vnto 16. the length of A D the baſe, and there riſeth 20. multiplie 10. the halfe of that 20. by 8. pearches the length of the ſaid perpendicular line, and the ſumme will be 80. pearches which make by reduction two rood the area of the ſaid peece of land like vnto the trapezium depicted in this chapter.



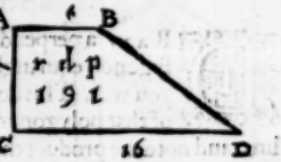
CHAP. XVIII.

How you may meaſure by two diuers wayes the area of the trapezium depicted in this chapter.

ADde togither the lengthes in the two parallell ſides of this trapezium: that is to ſay adde the length of the ſide A B to the length of the ſide C D, multiplie halfe of the product in the length of the perpendicular or ſide A C, and take the ſumme that amounteth for the area of the ſaid trapezium. As for example admitting that A B C D is the peece of land or trapezium to be meaſured, and that A B one parallel ſide thereof is 6. pearches in length, and that C D the other parallel ſide is 16. pearches in length, and that A C the perpendicular of this trapezium is ſeuen pearches in length, adde 6. pearches vnto 16. pearches, and the product thereof will be 22. pearches, multiplie 11. pearches the halfe of 22. pearches by ſeuen

pearches

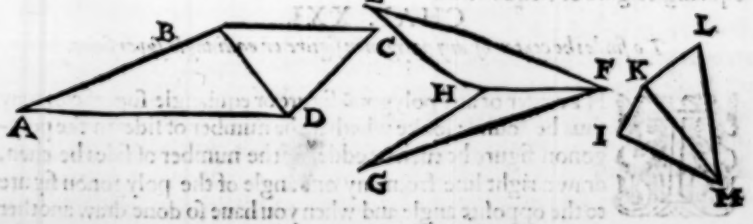
pearches, and there riſeth 77. pearches which make by reduction one roode, 9. dayworkes, and one pearch the area of the ſaid peece of land. Alſo the ſaid peece of land being brought into two triangles by a right line drawne from the angle C to the angle B, may be iuſtly meaſured, if you will (as you haue bene taught in the tenth chapter of this ſecond booke) meaſure the area or ſuperficiall content of euerie triangle ſeuerally, and adde their contents togither: for the ofcome therof ſheweth the area of all that trapezium or peece of land.



CHAP. XIX.

How you may meaſure a peece of land like in faſhion to any one of the three irregular figures drawne in the end of this 19. chapter.

DIVIDE A B C D the irregular figure or peece of land to be meaſured into two triangles, meaſure by the art taught in the tenth chapter of this ſecond booke the ſuperficiall content of euerie triangle ſeuerally, and adding their contents togither, take the ofcome for the area of the ſaid irregular peece of land A B C D. Likewiſe diuide the irregular peece of land E F G H into two triangles by drawing a right line from F to H, and afterwards meaſure the area thereof as you haue bene willed to meaſure the area of the ſaid irregular peece of land A B C D. Alſo if you wil make in I K L M the irregular peece of land to be meaſured two triangles by drawing a right line from the angle K to the angle M, and hauing meaſured the ſuperficiall content of euerie ſeuerall triangle by the art taught in the ſaid tenth chapter of this ſecond booke, will adde their products togither, you ſhall haue the area of all that irregular peece of land I K L M.

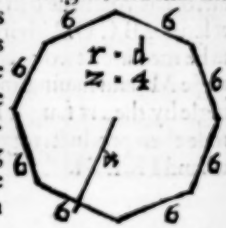


CHAP. XX.

To measure any peece of Land like vnto a polygonon figure or equiangle superficies how many equall sides soeuer it hath.

DRAVV a perpendicular line from the center of the land like a polygonon equiangle figure, vnto the mids of one equall side which you will. This done multiplie halfe of the lengthes in all the sides of that polygonon figure by the length of the said perpendicular line, and note the product thereof for the area of the said peece of land. As for example, admitting that the land to be measured is like vnto the polygonon equiangle figure of 5. equall sides here depicted, and that euerie one of the said sides is 12. pearches in length & that the perpendicular line drawne from the center of the said peece of land to the middes of one of the said sides which you will, is 8. pearches in length, adde togither the lengthes of all the said 5. equall sides, and there riseth 60. multiply 30. the halfe of 60. by 8. pearches the length of the said perpendicular line, and note the product thereof, that is to say, note 240 pearches (which make by reduction one acar, and two roode) for the area of the said peece of land like vnto a polygonon equiangle figure of fiue sides. Also you may measure in the same manner a peece of land like vnto any other polygonon figure how many equall sides soeuer it hath. As for example, admitting that the land to be measured is like vnto a polygonon equiangle figure of 8. equall sides, and that euerie one of the said sides is 6. pearches in length, and that the perpendicular line drawne from the center of this peece of land to the middes of one of the said 8. sides which you will, is foure pearches in length, multiplie 24. the halfe of the lengthes in all the 8. sides by 4. the length of the said perpendicular line, and note the product thereof, that is to say, note 96. pearches making by reduction two roode, and foure dayworkes, for the area of the said peece of land like vnto a polygonon equiangle figure of 8. equall sides.

The angles of a fiue angled figure are equall to 6. right angles because it may be brought into 3. triangles and that the three angles of euerie triangle are equall to two right angles.

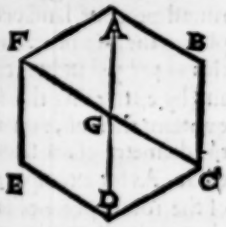


CHAP. XXI.

To finde the center of any polygonon figure or equiangle superficies.

THE center of any polygonō figure or equiangle superficies may thus be found: looke whether the number of sides in the polygonon figure be euen or odde. If the number of sides be euen, draw a right line from any one angle of the polygonon figure to the opposite angle, and when you haue so done, draw another right

right line from another angle in the ſaid polygonon figure to the oppoſite angle, and take the croſſe point of the ſaid two right lines for the deſired center of the ſaid polygonon figure which hath an euen number of ſides. As for example, admitting that the center of A B C D E F a polygonon equiangle figure of 6. ſides an euen number is to be found, draw a right line from the angle A, to D the oppoſite angle, and likewiſe draw a right line from the angle F, to C the angle oppoſite to F, and take G the croſſe point of the ſaid two right lines for the deſired center of A B C D E F, the polygonon figure of ſixe ſides an euen number, but when the number of ſides in a polygonon equiangle figure is odde, draw a right line from any one angle to the middes of the ſide which is oppoſite to that angle, and likewiſe drawe another right line from another angle (which for a difference ſhall here be called a ſecond angle) vnto the ſide lying right againſt that ſecond angle, and note the croſſe point of the ſaid two right lines for the deſired center of the ſaid polygonon figure which hath an odde number of ſides. As for example admitting that the center of H I K L M a polygonon figure of fiue ſides muſt be ſearched out, draw a right line from the angle H, to the middes of K L the ſide which is oppoſite to that angle, and another right line from M, to the middes of I K the ſide which lieth right againſt the ſaid angle M, and take N the croſſe point of the ſaid 2. right lines, for the center of H I K L M the polygonon figure of 5. ſides an odde number.

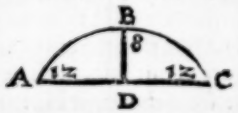


CHAP. XXII.

To know by foure ſundry wayes the length of the diameter of a round peece of land or circle.

MVLTIPLIE the circumference of a round peece of land or circle by 7, deuide the product therof by 22, and note the quotient for the diameter of the ſaid round peece of land or circle. As for example multiplie 88. pearches the circumference of the round peece of land or circle by 7, and the product therof will be 616. which diuided by 22. yeeldeth in the quotient 28. pearches for the diameter of the ſaid round peece of land or circle. Alſo by adding vnto the area of a round peece of land or circle $\frac{1}{11}$ of the ſame area, and extracting the ſquare roote out of the product, you may tell the length of the diameter of the ſaid round peece of land or circle. As for example admitting that the area of a round peece of land or circle containes 616. pearches, adde $\frac{1}{11}$ thereof (which make 168.) vnto the ſaid area 616, and there ri-

ſeth 784: extract the ſquare roote out of that number 784, & it will be 28. pearches which do ſhew the iuſt length of the diameter of the ſaid round peece of land or circle. Alſo by multiplying the area of a round peece of land or circle in 14. by diuiding the product therof by 11, and by extracting the ſquare roote out of the quotient thereof, you may tell the meaſure of the diameter of the ſaid round peece of land or circle. As for example admitting that the area of the round peece of land containes 616. pearches, multiplie 616. pearches by 14. and there riſeth 8624. diuide 8624 by 11, and the quotient will be 784. out of this quotient (I meane 784) extract the ſquare roote which is 28. and note it for the number of pearches in the iuſt length of the diameter of the ſaid round peece of land. Alſo by a ſection of a round peece of land or circle, you may tell the lēgth of the diameter in the ſaid round peece of land or circle, for if you will diuide the ſquare of halfe the length of the corde in that ſection by the altitude of the ſame ſectiō, and adde the quotient thereof to the ſaid altitude, you may take the product for the iuſt length of the diameter of the ſaid round peece of the land. As for example admitting that 12. pearches are halfe the length of A C the corde of A B C a ſection of a round peece of land or circle, and that 8. pearches are the altitude of the ſaid ſection, or (which is all one) the length of a right line drawne from B the middes or the higheſt point of A B C the arche line of that ſectiō, to D the middes of A C the corde of that ſection. diuide 144. the ſquare of 12. pearches which are $\frac{1}{2}$ of the length in the ſaid corde A C, by 8. pearches the length of B D the ſaid perpendicular line, and the quotient will be 18. pearches, which added to 8. pearches the lēgth of B D, produce 26. pearches for the deſired length of the diameter of the ſaid round peece of land or circle of which the ſaid A B C is a ſection.



CHAP. XXIII.

To meaſure by three ſundrie waies the circumference of any round peece of land or circle.

ARchimedes hath demonſtrated that the proportion of the circumference of any circle to his diameter is as 22. to 7. that is to ſay, triple and $\frac{1}{7}$: wherefore to meaſure the circumference of any round peece of land or circle, multiplie the diameter of the ſame round peece of lād or circle by 22. deuide the product by 7. and note the quotient for the meaſure of the deſired circumference. As for example multiplie 28. pearches the diameter

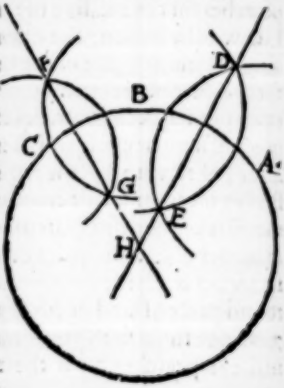
diameter of a round peece of land or circle by 22. and there riſeth 616. diuide this number 616. by 7. and the quotient will yeld 88. pearches for the meaſure of the deſired circumference. Likewiſe by tripling the diameter of a circle, and adding thereunto $\frac{1}{7}$ part of the ſaid diameter, you may tell the meaſure of the circumference of that circle. As for example triple 28. pearches the diameter of a round peece of land or circle and the product will be 84. adde 4. for $\frac{1}{7}$ of 28. vnto 84. the triple of 28. and ſo you ſhall find in the ſumme that amounteth 88. pearches for the meaſure of the deſired circumference. Alſo looke how many times 7. is in the diameter of a round peece of land or circle, ſo many times is 22. in the circumference of the ſaid round peece of land or circle. As for example the ſuppoſed round peece of land or circle is in diameter 28. pearches, and conſidering that 7. is foure times in 28. you may boldly ſay that foure times 22. pearches (which make 88. pearches) are in the meaſure of the ſaid circumference.

CHAP. XXIIII.

To finde out by two ſundrie waies the center of any round peece of land or circle aſsigned.

DRaw a corde croſſe the circle, diuide into two equal parts both that corde, and alſo the arche-line belonging to that corde, and from the prickes of thoſe diuiſions if you draw an other line croſſe the circle it muſt needes paſſe by the deſired center. Therfore deuide that line in the middes, and note the middle pricke for the center of the aſsigned round peece of land or circle. As for example admitting A B C D to be the round peece of the land or circle whoſe center you will ſeeke, draw a corde (which here ſhall be A C) croſſe the circle, diuide that corde in the middes, that is to ſay, in the point E. and likewiſe diuide his arche line A B C in the middes in the point B. and draw a right line from B along by E croſſe the circle vnto the point D, in which line is the center that you ſeeke for. Therefore diuide that right line B D in the middes into two equall partes, and note the middle pricke which here is F, for the deſired center of the aſsigned round peece of land or circle. Alſo you may finde the center of any round peece of land or circle in this maner. Make three prickes in the circumference of the round peece of land or circle at your plea-

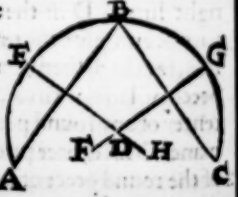
ſure where you will, then opening your compaſſe ſo wide that it be ſomwhat more than the halfe diſtance of thoſe prickes, ſet one foote of the compaſſe in the one pricke, and with the other foote draw an arche line towardes the other pricke, and when you haue ſo done, put one foote of the compaſſe vnaltered in the ſecond pricke, & with the other foote make an arch-line that may croſſe the firſt arche-line in two places. Now as you haue done with theſe two prickes, ſo do with the middle pricke and the third that remaineth, then draw two lines by the pointes, where the ſaid arche lines do croſſe, and where the ſaid two lines do meete there is the deſired center of the aſſigned round peece of land or circle. As for example admitting A B C to be three prickes made in a circumference, open your compaſſe ſo that they occupie more than the halfe diſtance betweene two prickes (as are A B) and then ſetting one foote in A, and extending the other towardes B, make the arche line D E. Likewiſe ſetting one foote of the compaſſe vnaltered in B, and turning the other towardes A, draw an other arche-line that will croſſe the firſt D and E. This done draw from D to E, a right line which is D H, and afterwards open the compaſſe to a new diſtance, and make two arche-lines betweene B and C which may croſſe one the other in F and G, by which two pointes draw F H an other right line. And becauſe the line D H, and the line F H; do meete in H, take the point H for the center of the ſaid circumference in which the three prickes A B C were made.



CHAP. XXV.

To finde a center to any ſection of a round peece of land or circle.

DIuide the arch line of the aſſigned ſectiō into two parts equall or vnequal at your pleaſure, & vnto each portion draw a cord. Thē diuide one of the arch lines in the midds, & alſo one of the cords, & draw a right line by thoſe two diuiſiōs which without doubt goeth by the deſired center. Afterwardes do likewiſe with the other arche line and his corde, and be not ignorant that where the ſaid two lines do croſſe, there is the center you ſeeke for. As for example admitting that A B C is the ſection of a round peece of land or circle vnto which you muſt ſeeke a center, diuide it into two partes, and let one of them be A B, and the other B C. Thē diuide euery part or arche in the middes, and



and so E will be the middes of A B,and G the middes of B C.Likewise marke the middes of their cordes with F and H, and set F by E, and H by G. Then draw a right line from E to F,& likewise draw a right line frō G to H, which two right lines do crosse in D where the desired center is.

CHAP. XXVI.

How whenyou haue any part of the circumference of a round peece of land, or any other circular thing, you may make out the whole circumference agreeing thereunto.

SEeke out the center of the part of the circumference of a round peece of land or circular thing assigned, as the second waie in the 24. chapter of this second booke teacheth, & then setting one foote of your compasse in the center, and extending the other foote vnto the part of the circūference, draw the whole round peece of land or other circular thing. As for example let A B D be a part of a circular thing: now to draw the whole circumference make three prickes in that part, and marke them with C D E. Then searche out the common center to them all as the second waie in the said 24.chapter of this second booke teacheth, and now that center being here F, set one foote of your compasse in F,& with the other foote set in C,D,or E, make out the whole circumference.

CHAP. XXVII.

To diuide the arche-line of a round peece of land or circle into two equall partes without measuring the arche-line.

DIuide the corde of that arche-line into two equall partes, and from the middle pricke erect a plumbe line, and it shall diuide that arche-line in the middes. As for example, admitting that A D C is the arche to be diuided,& that the corde is A B C, diuide the corde into two equall partes, and from B the pricke in the middes of the corde, erect a plumbe line,which marked here with B D, doth diuide the said arche into two equall partes in the point D.

CHAP. XXVIII.

To meaſure by fiue ſundry wayes the area of any round peece of land or circle.

MVltiplie the ſemidiameter of the roūd peece of land to be meaſured in the ſemicircumference, and note the ofcome for the area of the round peece of land or circle. As for example multiplie 14. pearches the ſemidiameter of a round peece of land in 44. pearches the ſemicircumference, and note the product therof, that is to ſay, 616. pearches for the area of the ſaid round peece of land. Or if you ſquare the diameter of a round peece of land, and hauing multiplied the ſaid ſquare by 11, diuide the product thereof by 14, the quotient will ſhew vnto you the area of the round peece of land. As for example, ſquare 28. pearches the diameter of the round peece of land to be meaſured, & the ſquare will be 784, multiplie that ſquare (I meane 784) by 11. & there ariſeth 8624, diuide the ſaid number 8624. by 14, and ſo the quotient will yeld 616. pearches for the area of the ſaid round peece of land. Or if you multiplie the ſquare of the ſemidiameter of any round peece of land to be meaſured by 22. the numerator of this fraction $\frac{22}{7}$, and diuide the product thereof by 7 the denominator of the ſaid fraction, the quotient will ſhew vnto you the area of the ſaid round peece of land.

The ſquare made of the diameter is in that proportion to the circle very neare as 14. to 11.

The area of a circle (as Archimedes hath demonſtrated) is equall to a triangle rectangle of whoſe two ſides containing the right angle, one is equall to the ſemidiameter of the circle, & the other to the circumference of the ſame.

As for exāple, ſquare 14. pearches the ſemidiameter of the round peece of land, & the ſquare therof will be 196, multiplie that ſquare (I meane 196) by 22. the numerator of this fraction $\frac{22}{7}$, and the product therof will be 4312, diuide the ſaid product 4312. by 7. the denominator of the ſaid fraction $\frac{22}{7}$, and note the quotient (which geueth 616. pearches) for the area of the ſaid roūd peece of land. Or if you multiplie the ſquare of the circumferēce of a round peece of land or circle by 7. the denominator of this fraction $\frac{88}{7}$, and diuide the product therof by 88. the numerator of the ſaid fraction $\frac{88}{7}$, the quotient will yeld the area of the ſaid round peece of land. As for example, ſquare 88. pearches the meaſure of the circumference, & the ſquare will be 7744, multiplie the ſaid ſquare 7744. by 7. the denominator of this fraction $\frac{88}{7}$, and there riſeth 54208, diuide this ſumme 54208. by 88. the numerator of the ſaid fractiō $\frac{88}{7}$, and note the quotient (which yeldeth 616. pearches) for the area of the ſaid round peece of land. Or if you multiplie the ſquare of the ſemicircumference by 7. the denominator of this fraction $\frac{22}{7}$, and diuide the product thereof by 22. the numerator of the ſaid fraction $\frac{22}{7}$, the quotient will yeld the area of the ſaid round peece of land. As for example, ſquare 44. pearches the meaſure of the ſemicircumference, and the ſquare will be 1936; multiplie the ſaid ſquare 1936.

by

by 7. the denominator of this fractiō $\frac{22}{7}$, & the product wil be 13552, diuide this product 13552. by 22. the numerator of the said fraction $\frac{22}{7}$, and note the quotient (which yeldeth 616. pearches making by reductiō three acars, three roode, and foure dayworkes) for the area of the said round peece of land.

CHAP. XXIX.

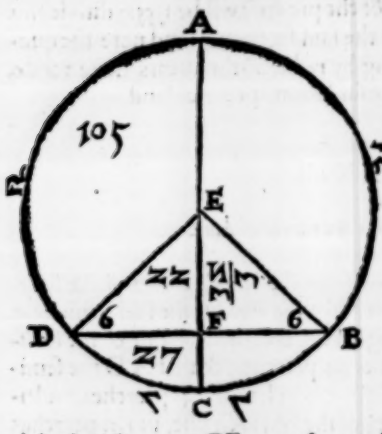
To measure the area of a semicircle of land.

MVLTIPLIE $\frac{1}{2}$ of the arch-line in the semidiameter of the semicircle, and note the product for the area of the said semicircle. As for example, admitting that A B C the arch line of the semicircle here depicted cōtaines 44. pearches, & that A D the semidiameter of the same semicircle is in length 14. pearches, multiply 22. pearches which are $\frac{1}{2}$ of the said arch line, in 14. pearches the length of the said semidiameter, and note three hundred and eight pearches (making by reduction one acar, three rood, and seauen daiworks) the product thereof, for the area of the said semicircle or peece of lande like vnto a semicircle.

CHAP. XXX.

To measure the area of any section of a round peece of land or circle.

ADMITTING that A B C D is a round peece of land, and that A B E D is a section thereof to be measured, drawe a corde from B to D, draw a semidiameter from the center E vnto D one end of the cord, and draw an other semidiameter from E the said center vnto B the other end of the said cord, whereby A B C D the said round peece of land will be diuided into three partes, that is to say, A B E D which is a section greater than a semicircle, E B D which is a triangle Isosceles, and B C D which is a section lesse than a semicircle, then noting E B C D for the sector of that rounde peece of land A B C D, multiply the length of the semidiameter E B, or E D (which we will here admit to be 7. pearches) in 15. pearches the $\frac{1}{2}$ of the supposed measure in the arch line D A B, and note the product thereof that is to say, note 105. pearches for the area of the said section A B E D. Now if you will measure the area of the said triangle Isosceles, multiply $\frac{1}{2}$ of the length of the perpendicular line F E, in the length of the whole base B D, or contrari-



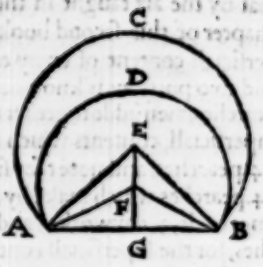
wiſe, multiply 3. ½ the whole length of the perpendicular in ſixe the halfe of the length of the corde B D, and thereof commeth 22. pearches the area of the ſaid triangle: which added vnto 105. pearches the area of the ſaid ſection A B E D, produce 127. pearches for the area of the ſection A B D. But if you will meaſure the area of B C D the ſection leſſe thã a ſemicircle, ioine E B D the ſaid triangle, vnto B C D the ſaid ſection leſſe than a ſemicircle, and multiplying ſeauen pearches the halfe of the meaſure in the arch line of the ſaid ſection B C D, by ſeauen pearches the half of the length of the ſemidiameter C E, note the product which maketh 49. pearches for the area of B C D E the ſector of that round peece of land, and then ſubtracting 22. pearches the area of the ſaid triangle out of 49. pearches the area of the ſaid ſector B C D E, take the remainer (which maketh 27. pearches) for the area of B C D the ſaid ſection leſſe than a ſemicircle.

CHAP. XXXI.

To meaſure the area of any peece of land like vnto a lunula.

WHEN a lunula is leſſe than a ſemicircle as is this lunula A B C D here depicted, draw a right line or cord from A to B, and meaſure the area of A C B D the whole figure (as you haue bene taught in the 30. chapter of this ſecond booke to meaſure the area of the ſection B C D leſſe than a ſemicircle) and reſerue the area of that whole figure. Againe meaſure after the ſame manner the area of the ſection A D B an emptie or void roome in the ſaid lunula A C B D, and afterwards ſubtracting the area of that ſection A D B from the ſaid reſerued area, note the remainer for the deſired area of the ſaid lunula A B C D, which is leſſe than a ſemicircle. But when a circular figure is greater than a ſemicircle, as is this figure A F B C D E, draw a cord from one ſharpe point thereof to the other, and hauing meaſured the area of the whole figure A B C (as in the ſaid 30. chapter of this ſecond booke you haue bene taught to meaſure the area of A B D a greater ſection than a ſemicircle) reſerue the area of all that figure A B C. This done meaſure in the ſame ſort the area of A D B the emptie

or



or void roome of the ſaid figure or lunula ABC, and ſubtracting the ſaid area of A D B from the reſerued area of the ſaid figure or lunula A B C, note the remainer for the area of the ſaid lunula A C B D. As for example, admitting that the length of the right line A B containes eight pearches, and that the meaſure of the arch line A C B containes 36. pearches, and that the ſemidiameter E A, or E B, containes in length ſeuen pearches, multiplie 18. the halfe of the meaſure of the ſaid arch line A C B by ſeuen pearches the length of one of the ſaid ſemidiameters, and there riſeth 126. pearches: and then to meaſure the triangle A E B. whoſe baſe A B. is 8. pearches in length, and whoſe perpendicular E G. is 6. pearches in length, multiplie 3. the halfe of the ſaid perpendicular in eight pearches the length of the ſaid baſe A B. and there will come 24. pearches, adde 24. pearches vnto the ſaid 126. pearches, and the ſumme amounting maketh 150. pearches the area of all the ſaid figure A C B. This done reſerue the area of A C B. and then to meaſure the area of A B D. whoſe arche line is in meaſure 29. pearches, and whoſe ſemidiameter F A. or F B. is in length 6. pearches, multiplie three the halfe of ſixe in 29. and reſerue the product which is 87. & after this to meaſure the area of the triangle A F B. whoſe baſe A B. is 8. pearches in length, and whoſe perpendicular G F. is 4. pearches and $\frac{1}{7}$ of a pearch in length, multiplie two pearches and $\frac{1}{7}$ of a pearch the halfe of the length of the ſaid perpendicular G F. in 8. pearches the length of A B. the ſaid baſe, and the product maketh 18. $\frac{4}{7}$ which added vnto the ſaid reſerued product of 87, make 105. and $\frac{4}{7}$ the area of the ſaid emptie or voide roome A D B. then abating the ſaid 105. and $\frac{4}{7}$ out of 150. the area of all the ſaid figure A C B. there will remaine 44. pearches and $\frac{3}{7}$ of a pearch for the area of the ſaid lunula A C B D.

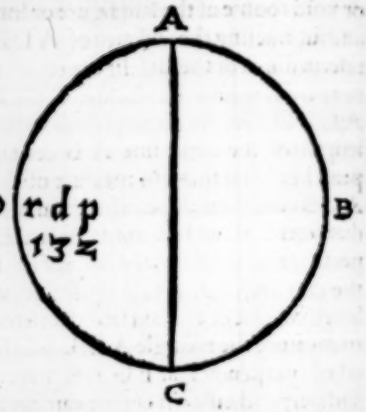
CHAP. XXXII.

How you may meaſure the area of a peece of land like in forme to an egge.

TO meaſure a peece of land like in forme vnto an egge, diuide it by drawing a cord from one ende thereof to the other, into two equall portions of a circle. After this meaſure as you haue bene taught in the 30. chapter of this ſecond booke, the ſuperficiall content of euery one of the ſaid two portions, and adding together their ſaid ſuperficiall contents, note the ſumme amounting for the area of the ſaid peece of land like in forme vnto an egge. As for example admit A B C D to be an egge fourme that muſt be meaſured, and that the corde A C doeth diuide the ſaid egge forme into two equall portions, and

that

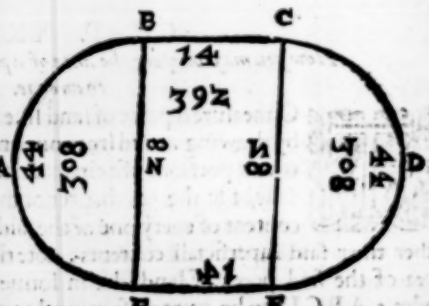
that by the art taught in the ſaid 30. chapter of this ſecond booke the ſuperficiall content of euery one of the ſaid two portions is knowne to be 27. pearches, then adde together the ſame ſuperficiall contents which do make 54. pearches, and note that ſumme of 54. pearches which make by reductiõ one roode, 3. dayworks, and 2. pearches, for the ſuperficiall content or area of the ſaide peece of land, which (for that it is like in figure and ſhape vnto an egge duely proportioned) I haue named an egge forme.



CHAP. XXXIII.

To meaſure the area of a peece of land which at each end is like vnto a ſemicircle, and in the middle like vnto a long ſquare.

THe area of a peece of land which at each end is like vnto a ſemicircle, and in the middle like vnto a long ſquare may thus be knowne. Meaſure the ſuperficiall content of the long ſquare in the ſaid peece of land as you haue bene taught in the 13. chapter of this ſecond booke. Alſo meaſure by the art taught in the 29. chapter of this booke, the ſuperficiall content of each ſemicircle in the ſaid peece of land, and when you haue ſo done, adde together all the ſaid ſuperficiall contents, and take the ſumme that amounteth for the ſuperficiall content of that peece of land which is at each end like vnto a ſemicircle, and in the middle like vnto a long ſquare. As for example, multiplie 14. pearches the length of B C a ſide of the long ſquare, in 28. pearches the length of B F another ſide of the ſaid long ſquare, & the product giueth 392. pearchs for the ſuperficial content of the ſaid long ſquare B C E F. This done, multiplie 14. pearches the ſemidiameter of the ſemicircle F A B, by 22. pearches the halfe of the arch line of that ſemicircle F A B, and note the product which maketh 308. pearches for the ſuperficiall content of the ſaid ſemicircle F



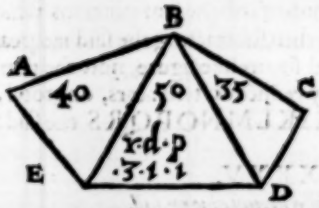
AB

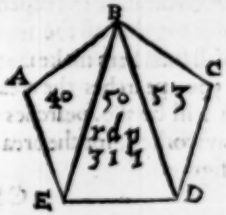
A B. Likewiſe multiplie 14. pearches the ſemidiameter of the ſemicircle C D E, in 22. pearches the halfe of the arch line of the ſaid ſemicircle C D E, and note the product which maketh 308. pearches for the ſuperficiall content of the ſaid ſemicircle C D E, and then adding together the ſaid 392. pearches, 308. pearches, and 308. pearches, note the ſumme that amounteth (that is to ſay, note 1008. pearches making by reduction 6. acars, one rood, and two day-works) for the ſuperficiall content of the ſaid peece of land, which at each end is like vnto a ſemicircle, and in the middle like vnto a long ſquare.

CHAP. XXXIIII.

To bring any right lined figure into a certaine number of triangles; to meaſure the ſuperficiall content of any right lined figure of what forme ſoeuer it be: and to tell what number of angles in a right lined figure, are equall to two right angles.

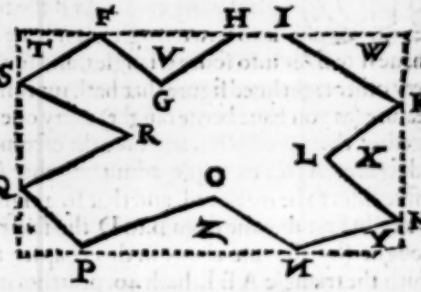
BY drawing right lines from one angle in a right lined figure to another oppoſite angle, bring the ſaid figure into ſo few triangles as you may poſſible do: that is to ſay, looke how many ſides the figure hath, and bring it into ſo many triangles ſauing two. As if the figure haue foure ſides bring it into two triangles, if it haue fiue ſides into three triangles, if it haue ſixe ſides into foure triangles, and ſo conſequently and infinitly bring euery other right lined figure that hath more ſides into triangles. Which done meaſure (as you haue beene taught) euery one of the triangles ſeuerally, adde together their products, and take the ofcome for the area of the ſaid right lined figure. As for example, admitting that A B C D E. is a right lined figure of fiue ſides to be meaſured, and that by a right line drawne from B. to E and by a right line drawne from B. to D. the ſaid right lined figure of fiue ſides is brought (by the rule aboue in this chapter taught) into three triangles, of which the triangle A B E. hath 40. pearches in his ſuperficiall content, the triangle E B D. hath fiftie pearches in his ſuperficiall content, and the triangle





B C D. hath 35. pearches in his ſuperficiall content, adde together 40. pearches, fiftie pearches, and 35. pearches, and note the ſumme that amounteth (that

is 125. pearches making by reduction three rood, one dayworke, & one pearch, for the ſuperficiall content of all that rightlined figure ABCDE. And here by the way I muſt tell you that for the better knowledge of triangles it is requiſite that you ſhould note that the three angles of euery triangle are equall to two right angles, and that if you multiplie the number of the triangles into which the rightlined figure is brought, by two, you ſhall haue the number of right angles to which the angles of the right lined figure are equal, and by this you may ſee that the angles of euerie quadrangled figure are equall to 4. right angles, becauſe it may be brought into two triangles: ſo the angles of a fiue angled figure are equall to ſixe right angles, becauſe it may be brought into three triangles, and ſo forth in like order. But when you ſhall perceiue that many triangles muſt of neceſſitie be drawne in a rightlined figure to be meaſured, then to ſaue ſome part of your labour, adde a portion, or (if need ſhal require) diuerſe portions vnto that rightlined figure, and make of it a ſquare, or ſquarelike figure. This done, meaſure (as you haue bene taught) the area of that ſquare, or ſquarelike figure, and the ſuperficiall content of euerie added portion. After this ſubtracting from that area the ſuperficiall contents of the added portions, note the remainer for the area of the ſaid rightlined figure. As for example, admitting that FGHIKLMNOPQRS is a right lined figure, which to be meaſured by the rules of triangles muſt of neceſſitie be brought into many triangles, make of it, to ſaue ſome labour, a ſquarelike figure by adding thereunto TVWXYZ*.2 eight portions, and afterwards meaſure (as you haue bene taught) the area of the ſaid ſquarelike figure, which here ſhalbe ſuppoſed to containe 500. pearches. Alſo meaſure the ſuperficiall content of euerie one of the ſaid portions, and adde togither all the ſuperficiall contents of the ſaid portions which by ſuppoſell ſhall here make 120 pearches, then ſubtracting the ſaid 120. pearches from 500. pearches the area of the ſaid ſquarelike figure, note the remainer which will be 380. pearches making by reduction two acars, one rood, and fiue dayworkes, for the area of FGHIKLMNOPQRS the ſaid right lined figure.



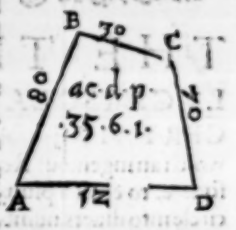
A note of triangles

CHAP. XXXV.

To meaſure the area of a mountaine or hill.

MEASVRE with your inſtrument, wyer line, or otherwiſe, the circuite in the foote of the mountaine or hill: alſo meaſure with your inſtrument,

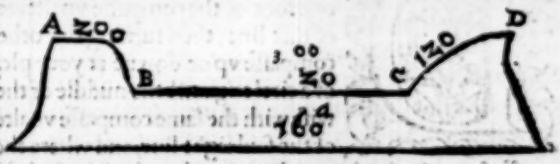
wyer line, or otherwiſe, the circuite in the toppe of the mountaine or hill, and adde both thoſe circuits togither, then meaſure with your inſtrument, wier line or otherwiſe, two aſcenſes of the mountaine or hill, that is to ſay, the going vp from the foote to the toppe of the mountaine or hill in two places, and hauing ioyned the meaſure of the longer aſcenſe, vnto the meaſure of the ſhorteſt aſcenſe, multiplie ½ of the ſaid aſcenſes ioyned together, in ½ of the ſaid circuits added together, and take the product for the area of the mountaine or hill. As for exãple admitting that A B C D is a mountaine or hill to be meaſured, and that 120. pearches are in A D the circuite of the baſe, and that 30. pearches are in B C the circuite of the top, and that 70. pearches are in C D the one aſcenſe of the mountaine or hill, and that 80. pearches are in A B the other aſcenſe of the mountaine or hil, multiplie 75. pearches the halfe of both the ſaid circuits in 75. pearches the halfe of both the ſaid aſcenſes, and note the product (which bringeth 5625. pearches, making by reduction 35. acars, 6. dayworks, and 1. pearch) for the area of A B C D the ſaid mountaine or hill.



CHAP. XXXVI.

To meaſure the area or ſuperficiall content of a valley.

TO know the area or ſuperficiall content of a valley, meaſure with your inſtrument, wyer line, or otherwiſe, the circuit in the heigth of the valley, & likewiſe the circuit in the depth of the valley, & adde both thoſe circuites togither. This done meaſure with your inſtrument, wyer line or otherwiſe, two deſcenſes, that is to ſay, the going down in two places from the heigth of the valley to the depth of the valley, & adde both thoſe deſcenſes together. After all this multiplie ½ of both thoſe circuites, in ½ of both thoſe deſcẽſes, & take the product for the area or ſuperficiall cõtent of the valley. As for exãple, admitting that A B C D is a valley to be meaſured, and that in the circuite of the heigth of the valley there are 300. pearches, and that in the circuite of B C the depth of A D the valley there are 20. pearches, and that 200. pearches are in A B the one deſcenſe of the valley, and that 120. pearches are in D C the other deſcenſe of the valley, multiplie 160. pearches the ½ of both the ſaid circuites in 160. pearches the halfe of both the ſaid deſcenſes, & take the product that is 25600. pearches making by reductiõ 160. acars for the area or ſuperficiall content of the ſaid valley.



The end of the ſecond Booke of Lucar-ſolace.

THE THIRD BOOKE OF LVCARSOLACE, CONTAINING PLAINE, CERTAINE; AND INFALLIBLE RVLES, BY

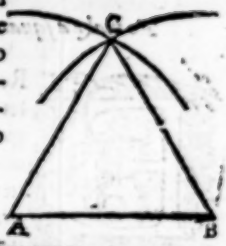
which an ingenious Reader may learne to make any triangle, ſquare, or long ſquare, to erect a plumbe line vpon any part or point of a line, to diuide any circle into diuers numbers of equall partes, to make any polygonon equiangle figure, to make an egge forme figure to know when a figure is inſcribed within an other figure or circumſcribed about an other figure, to inſcribe certaine rightlined figures within certaine other rightlined figures, to circumſcribe certaine rightlined figures about certaine other rightlined figures, to diuide a rightline into ſo many equall partes as he will, to tell whether a thing ſeene far of, doth ſtand ſtill, go from him, or come towardes him; to draw a right line equal to any aſsigned arche-line, or to the whole circumference of any aſsigned circle, or to any aſsigned part of a circle, to drawe a circular line equall to any aſsigned right line, to ſeparate, incloſe, and lay out within a long ſquare one, two, or three acars of land by diuers wayes from any peece of ground adioyning, to change a figure of one forme, into an equal figure of an other appointed forme, to make a rectiline angle equall to a rectiline angle geuen, to draw a parallel line to a line geuen, and to cube any aſsigned Sphere: in part, collected and tranſlated out of diuers Authors in diuers languages, and in part deuiſed by CYPRIAN LVCAR. Gent.

CHAP. I.

To make an equilater triangle on any right line geuen.

DRAVV a right-line of what length you will, and opening your compaſſe to the iuſt length of that line, ſtay one foot of the compaſſe vnaltered in one of the endes of that line, then turning the other foote of the ſame compaſſe vp or downe at your pleaſure, draw an arche of a circle againſt the middle of the line, and doe likewiſe with the ſame compaſſe vnaltered at the other end of the ſaid right line, and where the two arche-lines do croſſe, from thence drawe a line to each end of the ſaid firſt right line, and ſo you

you ſhall make an equilater oxigonium triangle. As for example A B is the right line that was firſt drawne, and therefore open your compaſſe ſo wide as that firſt line is long, and draw with the ſame compaſſe vnaltered two arche-lines that will meete in the point C ſet directly ouer the middle of the ſaid firſt line A B, and then drawing from C two other right-lines, one to A, an other to B, you haue made an equilater oxigonium triangle.



CHAP. II.

To make an Iſoſceles triangle on any right line geuen.

ADMIT AB to be a right line on which an Iſoſceles oxigonium triangle ſhall be made, and then conſider of the length that each of the other two ſides of the triangle ſhall containe, & to that length opening your compaſſe, ſtay one foote of the ſame compaſſe vnaltred in one of the ends of that line turning the other foote vp or downe at your pleaſure, and draw an arch of a circle againſt the middle of the line A B. Likewiſe ſtaying one foote of the ſame compaſſe vnaltered at the other end of the ſaid firſt line, draw againe with the other foote of the compaſſe an archline croſſe the firſt arch line, and then to finiſh this Iſoſceles oxigonium triangle, drawe from C the point in which the ſaid two archlines do croſſe, a right line to each end of your firſt line.

CHAP. III.

To make a Scalenum triangle on any right line giuen.

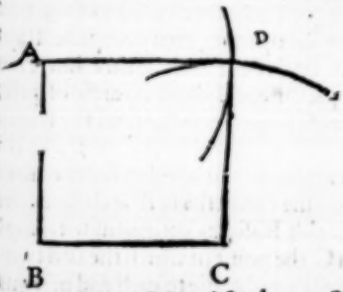
A B, C D, and E F are three lines of vnequall lengthes, and the ſaid line C D is the line on which the ſcalenum triangle ſhall be made. Now to make the ſaid ſcalenum, put the line C D for the baſe, & with your compaſſe take the length of the line A B. This done ſet one foote of your compaſſe vnaltered in C, and draw an arch line with the other foote. Likewiſe take the length of E F, and ſet one foote in D, & with the other foote make an arch line croſſe the other arch, and ſo the pricke of their meeting (which is G) ſhall be the third corner of the triangle, for in all ſuch workes to make a triangle if you haue one line drawne, there remaineth nothing els but to find where the pricke of the third corner ſhall be, for two of them muſt needs be at the two ends of the line giuen: and herewith this is to be noted, that the two ſides of a triangle muſt be ſuch, as the arches deſcri-

bed according to their quantitie may cut one the other.

CHAP. IIII.

To make a ſquare vpon any right line giuen, and alſo to make a long ſquare vpon any right line giuen.

ERect a plumbe line vpon one ende of the line giuen, and let the plumbe line erected be equall in length to the line giuen: then opening your compaſſe to the iuſt length of one of the ſaid lines, ſet one foot of the compaſſe vnaltred in the end of one of the ſaid lines, and with the other foote draw an arch line there as you thinke that the fourth corner ſhall be, after this, ſet the one foote of the ſame compaſſe vnaltered in the end of the other ſaid line, and draw another archline croſſe the firſt archline, and ſo the point that they do croſſe in is the pricke of the fourth corner or angle of the deſired ſquare. This done draw a right line from that pricke to the end of each line, and by ſo doing you ſhall mechanicaly make a ſquare. As for example, A B is a line giuen on which you ſhall make a ſquare: therfore erect a plumbe line vpon the point B, and that plumbe line is B C: then open your compaſſe to the length of the line AB, or to the length of the line B C (for they muſt be both of equall length) and ſet the one foote of the compaſſe vnaltered in C, and with the other foote make an arch line nigh vnto D: afterwards ſet one foote of the ſame compaſſe vnaltered in A, and with the other foote make an archline croſſe the firſt archline in D, and from the prick of their croſſing, draw two right lines one to A, and another to C, and then haue you made the deſired ſquare.



In this manner you may alſo make a long ſquare vpon a right line giuen, if you can remember that a long ſquare agreeth with a ſquare in that either of them hath right angles, and differeth from it onely by reaſon of his ſides in that the ſides of a long ſquare are not equall, as are the ſides of a ſquare.

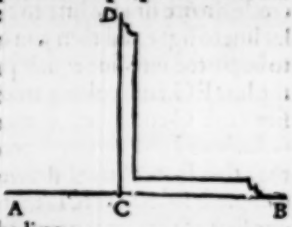
CHAP. V.

To erect by fiue wayes a plumb or perpendicular line vpon any part or point of a line appointed, and to draw a ſtraight line from any aſſigned prick that is not in a line, and make of the line ſo drawne a plumbe or perpendicular line to another line giuen.

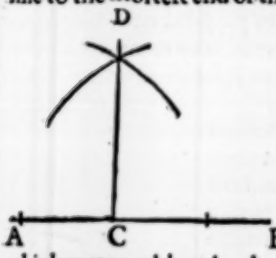
APplie the right edge of a ſquire to the part or point of the line on which the plube line ſhal be erected, & let the corner of the ſquire touch the ſaid

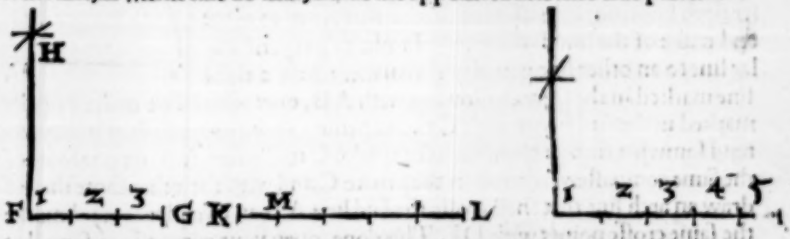
part

part or point. This done draw from that corner a line by the other right edge of the ſquire, and by ſo doing you ſhall erect a plumbe or perpendicular line vpon the ſaid point. As for example A B is here the line on which the plumbe or perpendicular line ſhall be made, and C is the part or point on which the plumbe or perpendicular line muſt riſe, therefore ſet one edge of your ſquire to the ſaid line A B, ſo that the corner of the ſquire do touch the ſaid point C iuſtly, and from C draw a line by the other edge of the ſquire (which here is C D) and ſo that line will be the deſired plumbe line.



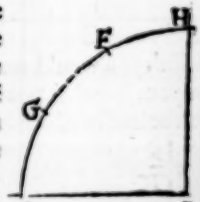
Or to erect a plũbe line on any part or point of a line appointed, open your compaſſe ſo that it be not wider than from the point geuen in the appointed line to the ſhorteſt end of the ſame line, but rather ſhorter. Then ſet one foote of the compaſſe vnaltered in the point ſo geuen, and with the other foote make two prickes one of each ſide of the point ſo geuen: afterward open your compaſſe to the widenes of thoſe two new prickes, & draw frõ them two arche-lines. This done if you marke their croſsing, and from it drawe a right line to the ſaid point geuen, it ſhall be a iuſt plumbe line on that point geuen but it happeneth ſometimes, that the pricke on which you would make the perpendicular or plumbe line is ſo neare the end of your line, that you can not extend any notable length from it to the one end of the line, in which caſe do thus, diuide the appointed line into fiue partes: and



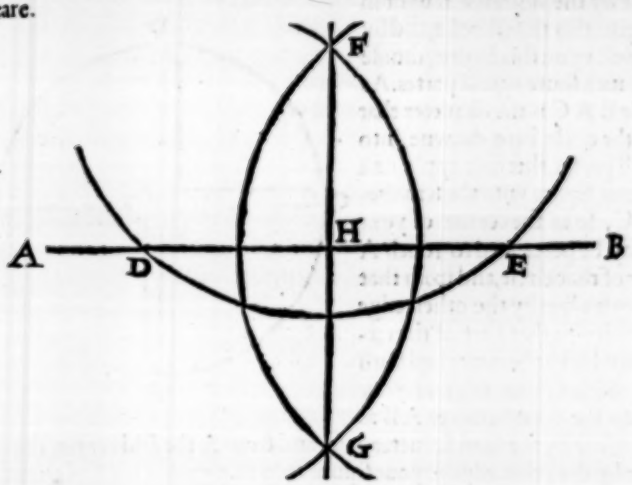


if it be not ſo long that it may yeld fiue notable partes, thẽ make an other line at will, and part it into fiue equall portions ſo as three of thoſe partes may bee found in your ſhort appointed line. Thẽ open your compaſſe ſo wide as three of theſe fiue meaſures be, and ſet one foote of the ſame compaſſe vnaltered in the point where you would haue your plumbe line to light (which I call the firſt pricke) & with the other foote draw an arche-line right ouer the pricke, as you can ayme it: after this open your compaſſe ſo wide as all fiue meaſures be,

and ſet one foote of the compaſſe vnaltered in the fourth pricke, and with the other foote draw an other arche-line croſſe the firſt, and where they two doe croſſe, thence draw a line to the point where you would haue the perpendicular line to light, and then you haue done. When the appointed line is to ſhort to be parted into fiue equall partes, diuide it into three partes onely as you ſee the line F G, and making an other line (as is K L) diuide it into fiue ſuch diuiſions as F G containeth three, and open your compaſſe ſo wide as foure parts (which are L M) ſet one foote of the ſame compaſſe vnaltered in F, and with the other foote thereof drawe an arche-line towardes H, after this open your compaſſe ſo wide as K L (that is to the widenes of all fiue partes) and ſetting one foot of the ſame compaſſe vnaltered in G (that is in the third pricke) draw with the other foote therof an other arche-line towardes H: and where the ſaid two arche-lines do croſſe (which is by H) there is the point from whence if you draw a right line vnto the point F, you ſhall make thereof a plumbe line as your deſire was to doe. Alſo to erect a plumbe or perpendicular line vpon any part or point of an appointed line, ſet one foote of your compaſſe in the pricke on which you would haue the plumbe line to light, and ſtretch forth the other foote thereof towardes the longeſt end of the line ſo wide as you can for the line, and ſo draw a quarter of a circle or more: then ſet one foote of the ſame compaſſe vnaltered in the ſame line where as the circular line did begin, and extend the other foote thereof in the circular line, ſetting a marke where it doth light, and adde halfe that quantitie more thereunto, & by that pricke that endeth the laſt part draw a right line to the pricke aſſigned, & ſo this line laſt drawē will be the deſired plumbe line. Likewiſe you may draw a ſtraigth line from any aſſigned pricke that is not in a line and make of the line ſo drawne a plumbe or perpendicular line to an other line geuen in this maner: draw a right line marked in the figure following with A B, ouer which line make a pricke marked in the ſaid figure with C then opening your compaſſe ſo as it may extend ſomwhat further than from the pricke C to the line A B, ſet one foote of the ſame compaſſe vnaltered in the pricke C, and with the other foote thereof draw an arch line that ſhall croſſe the ſaid line A B in two places, and marke the ſame croſſe points with D E. This done, open your compaſſe to ſomwhat more than halfe the diſtance betweene the ſaid croſſe points D E, and, and then ſetting one foote of the ſame compaſſe vnaltred in the ſaid point D, draw with the other foote thereof an arch line ouer the ſaid line A B. Againe ſetting one foote of the ſame compaſſe vnaltred in the ſaid point E, draw with the other foote thereof another archline ouer the ſaid line A B whereby the 2 arch lines laſt drawne wil cut one the other in the points F G, and then draw a right line from the ſaid pricke C ouer the point F vnto the point G, and where the ſaid



ſaid line A B is cut with the ſaid right line C F G, write H. All this being done you haue drawne a plumbe or perpendicular line from C an aſſigned pricke that is not in a line, vnto A B another line, as by the figure following will appeare.



CHAP. VI.

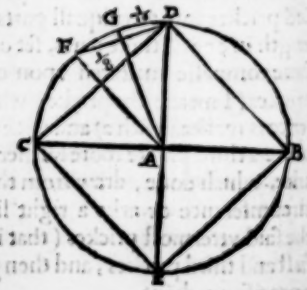
To make a quadrant which is ¼ of a circle, and to diuide any circle into two, foure, eight, ſixteene, or 32 equall parts.

DRAVV with your compaſſe opened to what widenes you will a circumference or an arke, that may be more or at the leaſt ſufficient for a quadrant, put both the feete of your compaſſe in that circumference or arke, making with them two pricks which may be marked for a difference with the figures 1 and 2, diuide the diſtance betweene the ſaid prickes into two equall parts, and then opening your compaſſe to the length in one of thoſe parts, ſet one foote of the ſame compaſſe vnaltered vpon one of the ſaid prickes (I meane the pricke, which for a difference is marked with 2) and with the other foote make a third pricke more farther vpon the ſaid arke, which done, draw from the center of the circumference or arke a right line to either of the ſaid vttermoſt prickes (that is to ſay) to the firſt and third prickes, and then you haue made a preciſe quadrant.

A diameter of a circle drawne by the center therof from one ſide of the circumference to the other, deuideth the circle into two equall partes as the diameter B A C doth here diuide a circle into two equall partes: which done you may eaſilie by the doctrine taught in the 5.chap.of this third booke,and by looking well vpon this figure, diuide any circle into foure equall partes.As for exãple B A C is the diameter that diuideth the circle here drawne into two equall partes,therfore apply one edge of your ſquire vnto the ſemidiameter A C, ſo as the corner of your ſquire may be perceaued to touch A the center of that circle,and from that center drawe a line by the other edge of your ſquire to that part of the circumferẽce which is here marked with E. This done lay an edge of your ſquire vnto the ſemidiameter A B as it did lie before by the ſemidiameter A C, and from A the ſaid center, draw another line by the other edge of your ſquire vnto that part of the ſaid circumference,which is here marked with D,and ſo without any more to doe, the circle is diuided into foure equall partes.

Alſo you may diuide a circle into foure equall parts by this meanes following.Inſcribe a ſquare within the aſſigned circle, which you may learne to doe by the art taught in the 17.chap.of this third booke, and then with your compaſſe opened to the iuſt length of one ſide of that ſquare, you may mechanicalie diuide the ſaid circle into foure equall partes: for the arke ouer any ſide of the ſaid ſquare is $\frac{1}{4}$ of the ſaid circle.

Now if you diuide with your compaſſe euerie one of the ſaid foure partes into two equall portiõs, the ſaid circle will be diuided into eight equall parts,or which in effect is all one, diuide the arke ouer any one ſide of the ſaid inſcribed ſquare into 2 equall parts, and from the middle pricke in the diuided arke drawe a right line to one of the extremes or endes of the ſaid arke. This done, open your compaſſe to the iuſt length of the ſaid right line or corde, and diuide therewith the ſaid circle into eight equall partes, which for that the arke ouer the ſaid right line or corde doth containe $\frac{1}{8}$



part

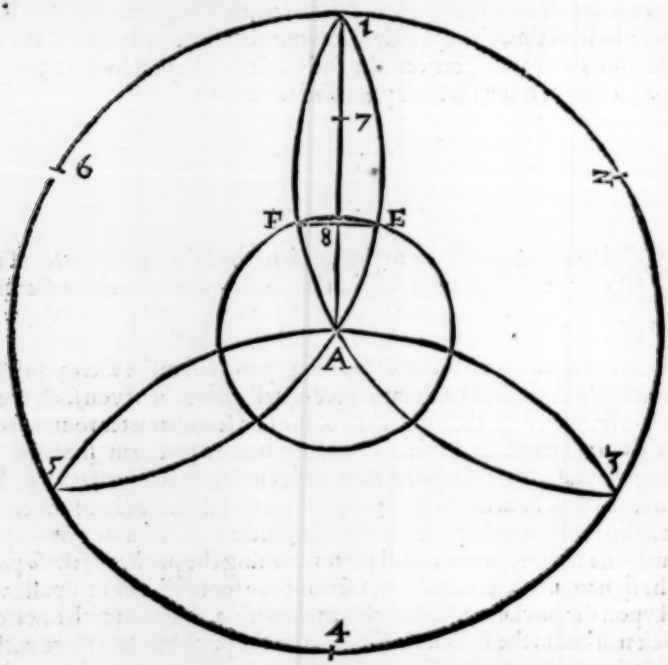
part of the ſaid circle, is eaſie to be done. And after thus if you diuide with your compaſſe each one of the ſaid 8. parts into 2. equall portions, the ſaid circle will be diuided into 16. equall parts, which may alſo be done after this maner. Diuide the arke marked in the ſaid circle with F D into 2 equal parts in the point G, and then opening your compaſſe to the iuſt length of a right line drawne from the ſaid point G, to any one ende of the ſaid arke F G, diuide therewith the aſſigned circle into 16. equal parts: which by reaſon the arch line G D, and likewiſe the arch line G F, is $\frac{1}{16}$ part of the circle, is alſo eaſie to be done. When you haue done all this, if you diuide with your compaſſe euery one of the ſaid 16. partes into two equall portions, the ſaid circle will be diuided into 32. equal partes which is the thing that was promiſed to be done.

CHAP. VII.

To diuide any circle into 3, 6, 9, 12, 18, or 24 equall partes.

OPEN your compaſſe to the iuſt length of the ſemidiameter of the circle that ſhall be deuided, then ſetting the ſame compaſſe vnaltred vpon the circumference of the ſaid circle, moue the compaſſe round about the circle, and at euerie ſecond mouing make a pricke in the ſame circumference: ſo doing, you ſhall make there 3. prickes which will deuide the ſaid cirele into three equall partes. So if you ſhall moue your cõpaſſe opened to the iuſt length of the ſaid ſemidiameter round about the ſaid circumference, and at euerie mouing make a pricke in the ſame circumference, you ſhall by ſo doing deuide the circle into 6. equall partes, but when a circle ſhall be deuided into 9. equall partes, deſcribe about the center (here marked with A) a large circle, part this circle (as before in this chapter you haue bene taught) into 6. equall partes marking the prickes of thoſe parts with the figures, 1. 2. 3. 4. 5. and 6. and ſetting one foote of your compaſſe vnaltered vpon the pricke marked in this circle with 2. drawe an arch line from the prick marked in the ſaid circle with 3. vnto the prick marked there with 1. Again ſetting one foot of the ſame compaſſe vnaltred vpon the prick marked with 4. draw an arch line from the prick marked with 5. to the pricke marked with 3. and after this ſetting one foote of the ſame compaſſe vnaltred vpon the pricke marked with 6. draw an arch line from the pricke marked with 1. to the pricke marked with 5. This done, draw a right line from the ſaid center A. to the ſaid pricke marked with 1. deuide this right line into 3. equall partes with 2. prickes marked in this deſcribed circle with the figures 7. and 8. and draw a ſquier line to the ſaid right line or ſemidiameter A. 1. ouer the figure 8. from one of the arches to the other of the ſame arches which doe enuiron the ſayd ſemidiameter A 1. and where the ſaid ſquier line toucheth the ſaid arkes write E and F. All this being done, open your compaſſe to the ſhorteſt extenſion

betweene the center A, & any one of the ſaid points E F, & ſetting one foot of the ſame compaſſe vnaltered vpon the center A, draw with the other foote thereof a circle right thorow the ſaid points E F. Now if you will open your compaſſe to the iuſt length of the ſaid archline E F, you may therewith part the circle laſt drawne into 9. equall portions, for the arke in that circle laſt marked with E F. is $\frac{1}{9}$ part of the circle laſt drawne.



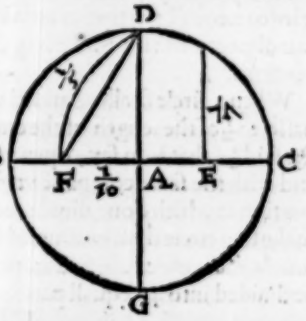
And here note that as a circle deuided into three equall parts, may alſo be diuided into nine equall portions by parting euerie one of the ſaid three parts into three equall portions, ſo a circle diuided into ſixe parts is diuided into 12. equall portions, by parting euerie one of the ſaid ſixe parts into two equall portions. Likewiſe it is to be remembred that a circle diuided into nine parts by parting euerie one of the ſaid nine parts into two equall portions, is diuided into 18. equall parts, and that a circle diuided into 12. equall parts by parting euerie one of the ſaid 12. parts into two equall portions, is diuided into 24 equall parts.

CHAP.

CHAP. VIII.

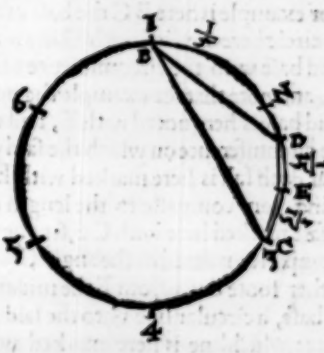
To deuide any circle into 5. 10. 15. or 20. equall parts, and to diuide any circle into 11. 22. or 44. equall parts.

DRAVV with your compaſſe a circle which muſt be diuided into foure equall parts with two croſſe diameters marked with B C D G, marke the center thereof with A, and hauing diuided the ſemidiameter A C into two equall parts in the point E, ſet one foote of your compaſſe in the ſaid point E, extend the other foot of the ſame compaſſe to the point D, from whence draw an archline to the ſemidiameter A B, and marke the touch of the ſaid lines (I meane the touch of the ſaid archline, and of the ſemidiameter A B) with F. This done, draw a right line from F to D, and then opening your compaſſe to the length of the ſaid right line F D, diuide therewith the ſaid circle into fiue equall parts: for the archline F D is $\frac{1}{5}$ part of the ſaid circle.



After you haue diuided with your compaſſe a circle into fiue equall portions, diuide euerie one of the ſaid fiue parts into 2. equall portions, and ſo that circle ſhall be diuided into ten equal parts. Or which in effect is al one, open your compaſſe to the length of the line A F in the ſaid circle A B C D G, and with the ſame compaſſe vnaltered part the ſaid circle into tenne equall portions. And when you will diuide a circle into fifteene equall parts, diuide the circle with your compaſſe firſt into fiue equall partes, and then diuide euerie one of the ſame fiue parts into three equall portions, and ſo the ſaid circle ſhall be diuided into fifteene equal portions.

Alſo a circle may be diuided into 15. equall parts after this manner. Diuide the appointed circle into ſixe equall parts as you haue bene taught in the 7. chapter of this booke, draw a right line from the firſt prick of the ſame diuiſions vnto the third pricke of the ſame diuiſions: which line in this appointed circle is B C, and hauing found out by the art before taught in this chapt. a right line that wil mea-



ſure out $\frac{1}{7}$ part of this appointed circle, open your compaſſe to the iuſt length of the ſaid right line, and ſetting one foote of the ſame compaſſe vnaltered vpon the ſaid point B, make a prick with the other foote thereof at D in the arch line B C. After this part the arch C D into two equall portions in the point E, draw a right line or cord from the point E to the point D, or from the point E, to the point C, and opening your compaſſe to the length of any one of the ſaid two cords, diuide therewith the appointed circle into 15. equall parts: for either of the ſaid arkes (I meane the arkes C E and E D) doth containe $\frac{1}{15}$ part of the ſaid appointed circle.

Alſo you may diuide a circle into 20. equall parts, if after you haue diuided it into 10. equall portions, you will part euerie one of the ſaid 10. parts into two equall portions: for that being done the circle is diuided into twentie equall portions.

When a circle ſhalbe diuided into 11, 22, or 44, equall parts, open your compaſſe to $\frac{1}{4}$ of the length of the diameter in the appointed circle, and to $\frac{1}{4}$ part of the ſaid $\frac{1}{4}$ (that is to ſay, open your compaſſe to $\frac{2}{11}$ parts of the ſaid diameter) and with the ſame compaſſe vnaltered, part the appointed circle into 11. equall portions: which done, diuide each of thoſe portions into two equal parts, and ſo the ſaid circle ſhall be diuided into 22. equall parts, and afterward if you will diuide each one of the ſaid 22. parts into two parts, the appointed circle ſhall be diuided into 44. equall parts.

CHAP. IX.

To diuide any circle into 7. 14. or 28. equall portions.

DESCRIBE a circle which here for example is A B C E, and inſcribe within that circle an equilater triangle, according to the doctrine taught in the 15. chapter of this booke. Then marking each angle of the ſaid triangle with a different letter or figure, as here for example the angles of the triangle are marked with A B C, diuide one ſide of the ſaid triangle into two equal portions, which ſide for example is here B C the baſe of the ſaid triangle, and from the center of the circle here marked with D, draw a perpendicular line ouer the midds of the ſaid baſe vnto the circumference of the ſaid circle, and note that for example the middes of the ſaid baſe is here noted with F, and the part of the circumference on which the ſaid perpendicular doth fall is here marked with E. Then opening your compaſſe to the length of halfe that baſe marked here with C F, ſet one foote of the compaſſe vnaltred in the angle C. and with the other foote draw from F the middle of the ſame baſe, a circular line vnto the ſaid circumference: whichline is here marked with F G.

This

This done, if you do open your compaſſe to the iuſt length ofthe right line drawne betweene the arke C G which containes $\frac{1}{7}$ part of the ſaid circles circumference, or to the length of the line F C, or to the length of the line F B, you may quickly diuide with the ſame compaſſe vnaltered the ſaid circle into ſeuen equall portions: which done if you diuide euerie one of the ſame ſeuen equall portions into two equall parts, the ſaid circle will be diuided into 14. equall portions. And afterwards if you diuide euerie one of the ſaid 14. equall parts into two equall portions, the ſaid circle will be deuided into 28. equall parts: which is the thing that was promiſed to be taught.

CHAP. X.

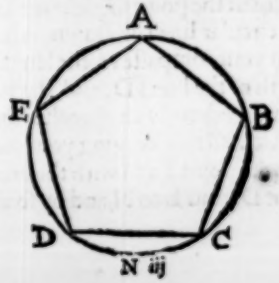
To diuide any circle into 360. equall portions.

THAT a circle giuen may be deuided into 360. equal parts, open your compaſſe to the iuſt length of the ſemidiameter of that circle, and mouing the ſaid compaſſe in that wideneſſe round about the circumference of the ſame circle, make a prick at euerie mouing with one foot of the compaſſe, as you haue bene taught in the ſeuenth chap. of this third booke, and by ſo doing you ſhall diuide that circle into ſix equall portions. This done diuide euery one of the ſaid ſix portions into 3. equall partes, and then the ſaid circle will be diuided into 18. equall portions. After this part euery one of the ſaid 18. portions into two equall deuiſions, whereby the ſaid circle will be diuided into 36. equall portions, and when you haue ſo done part euery one of the ſaid 36. parts into fiue equall portions, and ſo the ſaid circle ſhall be diuided into 180. equall partes. Laſt of all diuide euery one of the ſaid 180. partes into two equall portions, and then the ſaid circle will be diuided into 360. equall partes.

CHAP. XI.

To make any polygonon equiangle figure.

DESCRIBE a circle, and diuide the ſame into ſo many equall partes as you will haue ſides in your figure, this done, draw two lines frō euery pricke to the other two that are next vnto it, and by ſo doing you ſhall haue your deſire: As for example, behold here this figure A B C D E which is diuided into fiue equall partes by two lines drawne frō each pricke to the other two next prickes: that is to ſay, by two lines drawne from A, of which one is drawne from A to B, and the other is drawne frō the ſaid A to E, by two lines drawne from C, of which one is drawne frō C to B, & the other is drawne from the ſaid C to D, and by two lines

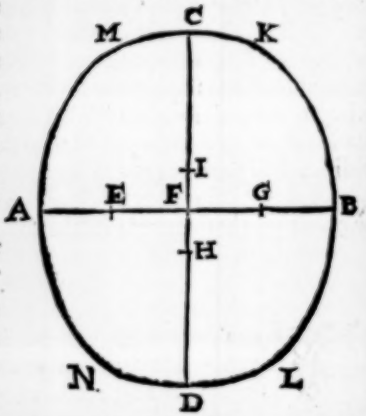


drawne from E, of which one in this figure was before drawne betweene the ſaid E and A, and the other was laſt of all drawne betweene the ſaid E & D. And in this order remembring that the circle muſt bee iuſtly diuided into ſo many equall partes as the figure ſhall haue ſides you may make any polygonon equiangle figure.

CHAP. XII.

To make an egge forme figure.

DRAVV a right line of what length you will, and let that line be here for an example A B, croſſe that line A B in the middes therof with a ſquire line which muſt be longer than the ſaid line A B, & let that ſquire line be here marked for an example with C D. Then diuide the ſaid line A B into foure equall partes here marked with A E, E F, F G, and G B, and opening your compaſſe to halfe the lēgth of one of the ſaid foure equall partes, ſet one foote of the ſame compaſſe vnaltered vpon the ſaid line A B in the point F, & make two prickes with the other foote of the compaſſe in the line C D: one betweene the points F C, & the other betweene the pointes F D: and conſidering that the ſaid prickes ought to be marked with different letters or figures, I haue here marked the pricke between F C with I, and the pricke betweene F D with H. This done open your compaſſe to the iuſt length of the line A G, or (which is all one) to the iuſt length of the line B E, and ſetting one foote of your compaſſe vnaltered in the point E, deſcribe a circular line by the point B: which circular line is here for an example marked with K L. Againe ſetting one foote of your cōpaſſe vnaltered in the point G, deſcribe a like circular line by the point A: & note that this circular line laſt drawne is here marked with M N. When all this is done, open your compaſſe to the length of the line H C, or (which is all one) to the length of the line I D, and ſtaying one foote of the compaſſe vnaltered in the point H, draw with the other foote a circular line by the point C, from M to K. After all this keeping your compaſſe in that wideneſſe, ſtay one foote therof in the point I, and with the other foote deſcribe an other circular line by the point D from L to N, and by ſo doing you ſhall make an egge forme figure.

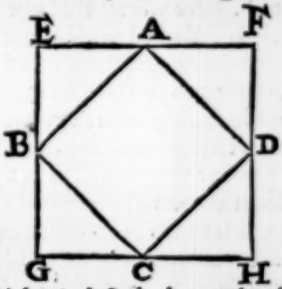


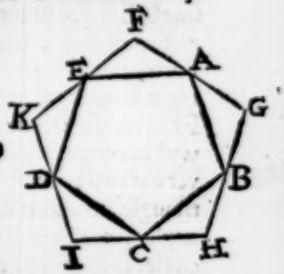
CHAP.

CHAP. XIII.

To know when a figure is inſcribed within an other figure and when a figure is circumſcribed about an other figure

YOV muſt vnderſtād that a rightline figure is ſaid to be inſcribed within a right line figure, when euery one of the angles of the inſcribed figure toucheth euery one of the ſides of the figure wherein it is inſcribed. As for exāple the triangle A B C is here inſcribed in the triangle D E F, becauſe euery angle of the triangle inſcribed, that is to ſay: the triangle A B C toucheth euery 1. *Definition.*





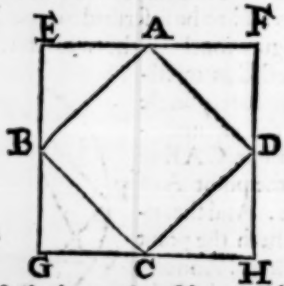
ſide of the triangle within which it is deſcribed, namely of the triangle D E F, as the angle C A B toucheth the ſide E D: the angle A B C toucheth the ſide D F, and the angle A C B toucheth the ſide E F. So likewiſe the ſquare A B C D is ſaid to be inſcribed within the ſquare E F G H, becauſe euery angle of it toucheth ſome one ſide of the other. So alſo the Pentagon or polygonon equiangle and equilater figure of fiue ſides A B C D E is ſaid to be inſcribed within the polygonon equiangle and equilater figure of fiue ſides F G H I K, becauſe euery angle of it toucheth ſome one ſide of the other.

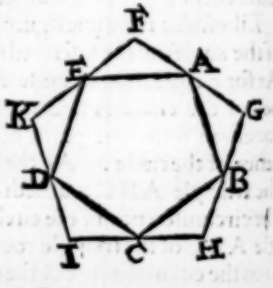
Likewiſe a rightline figure is ſaid to be inſcribed in a circle, whē euery one of the angles of the inſcribed figure toucheth the circumference of the circle. As for exāple, the triangle A B C, is inſcribed in the circle A B C becauſe euery angle toucheth ſome one point of the circumference of the circle. As the angle C A B of the triangle A B C toucheth the point A of the circumference of the circle. And the angle A B C of the triangle toucheth the point B of the circumference of the circle. And alſo the angle A C B of the triangle toucheth the point C of the circumference of the circle. In likemaner the ſquare A D E F is inſcribed in. 2. *Definition.*

the ſame circle A B C, becauſe euery angle of the ſquare inſcribed, toucheth ſome one point of the circle in which it is inſcribed. And ſo imagine you of other right lined figures.

3. *Definition.* Alſo a circle is ſaid to be inſcribed in a rightline figure, when the circumference of the circle toucheth euery one of the ſides of the figure within which it is inſcribed. As here for example, the circle A B C D is inſcribed within the triangle E F G, becauſe the circumference of the circle toucheth euery ſide of the triangle in which it is inſcribed: namely the ſide E F in the point B, and the ſide G F in the point C. and the ſide G E in the point D. Likewiſe by the ſame reaſon the ſame circle is inſcribed within the ſquare H I K L. And ſo may you iudge of other right lined figures: for though you may ſee in E F the two figures next following, that a circle is within a triangle, and a triangle within a circle, yet the circle is not named to bee inſcribed in a triangle, becauſe it doth not touch the ſides of the triangle, nor the triangle is ſaid to be inſcribed in the circle, becauſe one of his corners doth not touch the circumference of the circle,

4. *Definition.* Likewiſe this ought to be knowne, that a right-lined figure is ſaid to be circumſcribed about a right lined figure, when euery one of the ſides of the figure circumſcribed, toucheth euery one of the angles of the figure about which it is circumſcribed. As for example, the triangle D E F is ſaid to be circumſcribed about the triangle A B C, for that euery ſide of





the figure circumſcribed, namely, of the triangle D E F, toucheth euery angl of the figure about which it is circumſcribed. As the ſide D F of the triangle D E F circumſcribed, toucheth the angle A B C of the triangle A B C about which

which it is circumſcribed: and the ſide E F toucheth the angle B C A, and the ſide E D toucheth the angle C A B. And ſo vnderſtand you of the ſquare E F G H, which is circũſcribed about the ſquare A B C D: for euery ſide of the one toucheth ſome one ſide of the other. Euen ſo by the ſame reaſon the Pentagon or polygonõ equiangle figure of 5. ſides F G H I K is circumſcribed about the Pẽtagon or polygonon equiangle figure of fiue ſides A B C D E before in this chapter depicted. And thus you may of other rightlined figures conſider.

5. Definition.

Alſo a circle is ſaid to be circumſcribed about a rightlined figure, when the circumferẽce of the circle toucheth euery one of the angles of the figure about which it is circumſcribed. As in the former example of the ſecond definition, the circle A D E F is circumſcribed about the triangle A B C, becauſe the circumference of the circle which is circumſcribed toucheth euerie angle of the triangle about which it is circumſcribed: namely the angles C A B, A B C, & B C A. Likewiſe the ſame circle A D E F is circumſcribed about the ſquare A D E F by the ſame ſecond definition, as you may ſee.

6. Definition.

Alſo a rightlined figure is ſaid to be circumſcribed about a circle, when euery one of the ſides of the figure circumſcribed toucheth the circumference of the circle. As in the former figure of the third definition, the triangle E F G is circũſcribed about the circle A B C D, for that euery ſide of the ſame triangle circumſcribeth & toucheth the circumference of the circle, about which it is circumſcribed. As the ſide E G of the triangle E F G toucheth the circumference of the circle in the point D: and the ſide E F toucheth it in the point B: & the ſide G F in the point C. Likewiſe the ſquare H I K L is alſo circumſcribed about the circle A B C D, for euery one of his ſides toucheth the circumference of the circle, namely, in the pointes A, B, C, D. And thus conſider of all other regular rightlined figures (for of them onely are vnderſtanded theſe definitions) to be circumſcribed about a circle, or to be inſcribed within a circle, or of a circle to be circumſcribed, or inſcribed about or within any of them. And this alſo is to be noted that rightlined figures, which haue equall ſides & equal angles and are onely of one kinde or forme can be inſcribed or circumſcribed the one within or about the other. As a triangle within or about a triangle: A ſquare within or about a ſquare: and ſo a Pentagon within or about a Pentagon; and likewiſe of others of one forme: for a triangle can not be inſcribed or circumſcribed within or about a ſquare: nor a ſquare within or about a Pentagon. And ſo of others of diuers kindes.

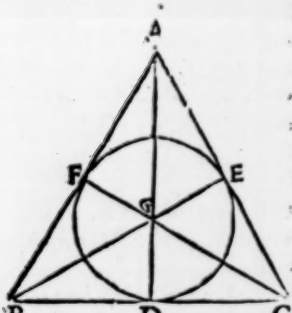
The inſcription & circumſcription of rightlined figures pertaine onely to ſuch rightlined figures which haue equall ſides and equall angles, and are commonly called regular.

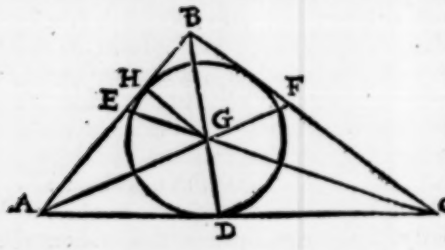
CHAP. XIIII.

To inſcribe a circle within a triangle.

WHen you purpoſe to inſcribe a circle within an equilater or Iſoſceles triangle, make a pricke in the middes of euerie ſide of that triangle, and from the oppoſite angle draw a right line vnto euerie one of thoſe prickes: then ſetting one foote of your compaſſe in the croſſing point of thoſe lines, ſtretch out the other

foote to the middle pricke in one of the ſaid ſides, and draw therwith a circle which by this meanes will touch euerie ſide of the triangle, and neuer paſſe without or beyond any of them. As for example part euery one of the ſides of this triangle A B C into two equall parts with theſe points D, E, F, putting F betweene A B, & D betweene B C, and E betweene A C. Then draw a right line from C to F, and another from A to D, and the third from B to E. After this in the croſſing point of the ſaid lines, that is to ſay, in the point G, ſet one foote of your compaſſe, & with the other foot ſtretched out to the point F, or to the point E, or to the point D, draw a circle which by this meanes will touch euerie ſide of the triangle, and may be ſaid to be inſcribed in the triangle, be it an equilater triangle, or an Iſoſceles triangle. For when a circle ſhall be inſcribed within a triangle of another kinde: I meane within a triangle that is no equilater or Iſoſceles triangle, then diuide euery angle of the triangle in the middes after this maner: open your compaſſe ſo wide as you wil, ſo that it do not exceede the length of the ſhorteſt line that incloſeth the angle that ſhall be diuided, and ſetting one foot of the compaſſe in the very point of the angle, draw with the other foote an arch from the one line of the angle to the other. Moreouer diuide that arch into two equall portions, and by drawing a right line from the angle to the middes of the arche, part the angle into 2. equall parts. This done, draw right lines from each angle ouer the middle prickes which diuide the ſame angles into equall partes vnto the ſubtending ſides, and from the croſſing point of the ſayd lines draw a perpendicular to one of the ſides of the triangle. Then opening your compaſſe to the length of the ſaid perpendicular line, ſet one foot of the compaſſe vnaltred on the ſaid croſſing point, and with the other foote draw a circle in the triangle, and by ſo doing you ſhall inſcribe a circle within that triangle. As for example, diuide the angles of this triangle A B C in their middes with D E, and F; draw the lines of diuiſion A F, B D, and C E, which wil croſſe in the point G, and draw G H a perpendicular from G to H. Finally ſetting one foot of the compaſſe in the point G, extend the other foot to the point H, and



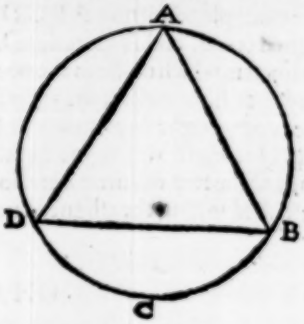


and ſo with the ſame compaſſe vnaltred draw a circle which wil iuſtly anſwer to that triangle. That is to ſay, the ſaid circle will be inſcribed in that triangle.

CHAP. XV.

To inſcribe an equilater triangle within a circle.

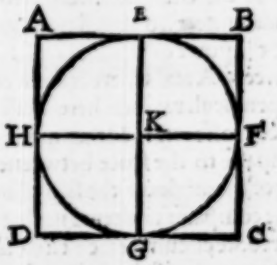
DIuide the circle into 3. equall parts ſeparating euery one of thoſe parts from other with a ſmall pricke as you haue bene taught in the 7. chapter of this third booke, drawe a right line from euery one of the ſaid prickes to other, and by ſo doing you ſhall inſcribe an equilater triangle within that circle. As for example admitting A B C D to be the circle in which an equilater triangle ſhall be inſcribed, and A B D to be the three ſmall prickes which diuide the ſayd circle into three equall parts, draw a right line from the prick A to the pricke B, alſo draw a right line from the pricke B to the pricke D, and laſt of all drawe a right line from the prick D to the pricke A, and then you ſhall ſee that by ſo doing you haue inſcribed an equilater triangle within a circle.



CHAP. XVI.

To inſcribe a circle within any aſſigned ſquare.

FIrſt diuide euery ſide of the ſquare into two equal parts, then draw two lines betweene each two oppoſite points, and note where the ſaid two lines do croſſe: this done, ſtay one foote of your compaſſe on that croſſe point, and ſtretching forth the other foote vnto the iuſt halfe of the length in one of the ſaid lines, inſcribe a circle in the ſquare aſſigned. As for example, A B C D is the aſſigned ſquare: therefore diuide firſt euerie ſide thereof into two equall parts, and thē draw two lines a croſſe betweene each two oppoſite prickes as in the figure here depicted, two lines are drawne a croſſe betweene the prickes E G, and F H. After this, for that the ſaid two lines do croſſe one the other in the point here marked with K, ſet one foote of your compaſſe in the point K, & ſtretching forth the other foote to the point E, inſcribe therewith a circle in the aſſigned ſquare.



CHAP. XVII.

To inſcribe a ſquare within any aſſigned circle.

CRoſſe the circle with two diameters which will make foure right angles, and draw foure right lines that ſhall ioine the foure ends of thoſe diameters, one to another. This done you haue inſcribed a ſquare within the aſſigned circle. As for example, admitting A B C D to be the aſſigned circle, and A C, and B D, to the two diameters which croſſe in the point here marked with E, & make foure right angles, draw foure other right lines that is A B, B C, C D, and D A which will ioyne togither the foure ends of the two diameters, and ſo is the ſquare inſcribed within the aſſigned circle.

CHAP. XVIII.

To circumſcribe a circle about any aſſigned triangle.

DIVIDE two ſides of the triangle equally in halfe, and from thoſe two prickes erect two perpendiculars, which will cut or croſſe one the other, and note the point of their interſection for the center of the circle that muſt be drawne or circumſcribed about the aſſigned triangle. This done, ſet one foote of your compaſſe in the ſaid point of interſection, extend the other foote to one angle of the aſſigned triangle, and therewith circumſcribe a circle about the ſame triangle. As for example, admitting A B C to be the triangle whoſe two ſides A B, and A C, are diuided into two equall parts in the points D and E, and that the point or pricke D is ſet betweene A and B, and E betweene A and C, erect from each of theſe two points a perpendicular which here ſhall be D F, and E F, which cut or croſſe one the other in the point F, & opening your compaſſe to the ſpace betweene the ſaid point F and any one of the angles of the ſaid triangle, ſet one foote of the ſame compaſſe vnaltered in that point F, and with the other foote circumſcribe a circle about the aſſigned triangle, which is the thing that was promiſed to be taught.

CHAP.

CHAP. XIX.

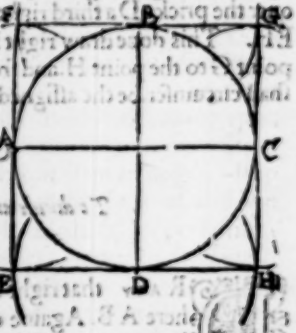
To circumscribe a circle about any assigned square.

DRAVV two lines betweene the foure angles of the square, and note that where the said two lines do cut or crosse one the other, there is the center of the desired circle. This done, set one foote of your compasse in that center, and extending the other foote vnto an angle of the square, draw therewith a circle about the assigned square. As for example, A B C D is the assigned square, therefore draw two lines crosse the said square frō angle to angle as here the lines A C & B D are drawne, and where the said two lines do crosse one the other (that is to say, in the point E) there set one foote of your compasse, and with the other foote extended vnto any one angle of the said square, circumscribe a circle about the assigned square.

CHAP. XX.

To circumscribe a square about any assigned circle.

DRAVV in the circle two diameters one crosse ouer the other, and so they will make foure right angles in the center of that circle, then with your compasse take the iust length of the semidiameter of the said circle, and stay-ing one foote of the compasse in each end of those diameters, draw two arch-lines at euerie pitching of the compasse, and so you shal make eight archlines. After this marke the prickes wherein the said archlines do crosse, and draw betweene those foure prickes, foure right lines, and then you haue circumscri-bed a square about the assigned circle. As for example, admitting A B C D to be the assigned circle, draw in it two diameters one crosse ouer the other, whereby they may make foure right angles, and in the figure here drawne the said two diameters are marked with A C, and B D. Then opening your compasse to the iust length of the semidiameter of the assigned circle, set one foote of your compasse in the end of euerie semidiameter, that is to say, in the points here marked with A B C and D, and with the other foote draw on euerie side two archlines here marked with E F G H, which done, betweene the prickes in the crof-sings of the said archlines, draw right lines here marked with E F, F G, G H, and H E, and by so doing you shall circum-

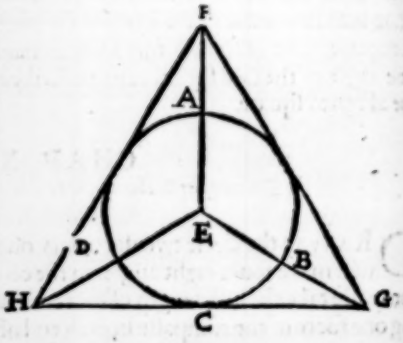


ſcribe a ſquare about the aſſigned circle.

CHAP. XXI.

To circumſcribe a triangle about any aſſigned circle.

AFTER you haue parted the aſſigned circle into three equall portions, and haue ſeparated each one of thoſe diuiſions from other with a ſmall pricke as you haue bene taught in the 7. chapter of this third booke, drawe from the center of the ſame circle ouer the circumference to euery one of the ſaid prickes a right line equal in lēgth to the diameter of that circle. Againe draw right lines betweene the endes of the other ſaid lines, & by ſo doing you ſhall circumſcribe a triangle about the aſſigned circle. As for example admitting A B C D to be the aſſigned circle, which is parted into three equall portions with three prickes here marked with A B, & D, & that the point E is the center of the ſaid circle, drawe from that center ouer the pricke A a right line equall in lēgth to the diameter of that circle, which line is here marked with E F. Likewiſe draw from the ſaid center ouer the pricke B an other right line of like length here marked with E G, and draw from the ſaid center ouer the pricke D a third right line of like length, which is here marked with E H. This done draw right lines from the point F to the point G, from the point G to the point H, and from the point H to the ſaid point F: and ſo you ſhall circumſcribe the aſſigned circle.

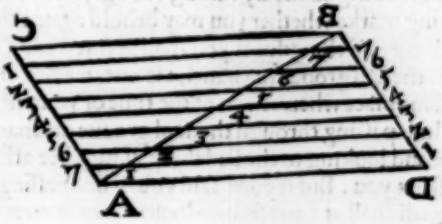


CHAP. XXII.

To diuide any right line into ſo many equall partes as you will.

DRAW that right line which ſhall be diuided, and let that line be here A B. Againe draw vnto either end of that line a perpendicular, one vpward, the other downwards, as here for example the perpendicular B D is erected vpon B one end of the ſaid line, and the perpen-

perpendicular A C is drawē downwards from A the other ende of the diuisible line. This done open your compasse to what widenes you will, measure out therwith so many equall partes in either perpēdicular as you purpose to make equall portions in the diuisible line, & then draw right lines from the prickes or pointes in one perpēdicular to the prickes or pointes in the other perpēdicular: that is to say, draw the first line between the first pricke in the one perpēdicular marked here with C, and the last pricke in the other perpendicular marked here with B, and in the same order proceede till you haue diuided the line geuen into so many equall portions as there are equall diuisions in the said perpendiculars.



CHAP. XXIII.

To know by the helpe of a ruler and a right line produced by the fiduciall edge of the same ruler vpon a table, drummes head, stoole, or other superficies, whether a ship vpon the sea, or an armie vpon the land, or any other thing seen a far of doth stand still, goe from you, or come towardes you.

IN the 67 chapter of my booke intituled LVCAR APPENDIX I haue taught you to worke this deuise with a gunners semicircle, & this notwithstāding I think it not vnmeet to shew here how you may also performe the same with a ruler laid flatlong vpon a table, drummes head, stoole, or any other smooth superficies: for which purpose when you shall espie from an heigth a ship vpon the sea, or an armie vpon the land, or any other thing a far of, and will know whether or no it commeth towardes you, standeth still, or goeth from you, place your table vpright and fast vpon one end in a perpendicular heigth ouer the horizon, right against the thing so seen, and afterwardes laying your ruler flatlong vpon the face of the table, moue it thereon vp or downe till you shall espie through the grooue or chanell of the same ruler the said thing. This done produce by the fiduciall edge of your ruler a right line: then suffering the said table to stand vnmouable, take your ruler from the table for a time

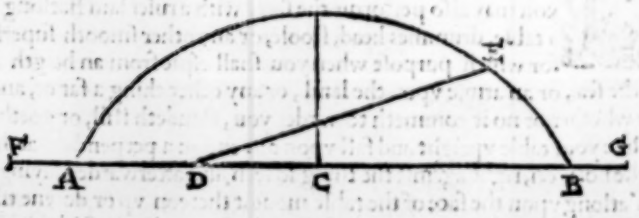
which may be ſo long or ſo ſhort a while as you will, and at the ende of your liked time, lay againe the fiduciall edge of your ruler vpon the ſaid produced right line looking aduiſedly through the grooue or channell of your ruler, and in ſo doing marke whether you may behold againe through the ſaid grooue or channell the ſaid thing: for if you ſhall at this ſecond looking behold it againe through the ſaid grooue or chanel, it is certaine that the ſaid thing ſtandeth ſtil in the ſame place where it was at the time of your firſt looking. And if your viſuall line paſsing through the ſaid grooue or channell ſhall not extend at your ſecond looking to the ſaid thing, it may bee affirmed that the ſaid thing goeth from you. But if your ſaid viſuall line paſſing through the ſaid grooue or channell ſhall at your ſecond looking reach ouer the ſaid thing, it is a manifeſt truth that the ſaid thing commeth towardes you.

This deuiſe may alſo be wrought vpon a drummes head, ſtoole, or other ſmooth ſuperficies: for one reaſon, and one rule ſerueth for them all, as before I haue written in the third chapter of my firſt booke of LVCARSOLACE.

CHAP. XXIIII.

To draw a right line that ſhall be equall to the right extenſion of any aſsigned arche line.

SVPPOSING A B to be the aſsigned archeline, diuide the corde of the ſaid archeline into two equall partes in the point C, and erect a plumbe line vpon that point vp to the ſaid archline. This done, diuide ½ of the ſaid cord, that is to ſay, diuide the line A C into two equall parts in the point D, and then opening your compaſſe to the length of ¼ of the ſaid cord, that is to ſay, to the length of the line A D, or to the length of the line D C, ſet one foote of the ſame compaſſe vnaltered in the point B, and with the other foote make a point or pricke in the ſaid archline at E. After this draw a right line from the ſaid point D to the ſaid pricke at



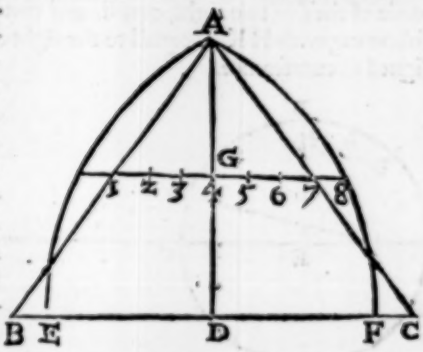
point E. Alſo produce the ſaid cord beyond either ſide of the ſaid arch, and opening your compaſſe to the iuſt length of the ſaid line D E, ſet one foote of

of the ſame compaſſe vnaltered in C, and with the other foote make a pricke vpon the ſaid produced cord beyond A, and marke that pricke with F. Likewiſe ſtaying one foote of the ſame compaſſe vnaltered in the ſaid point C, make a prick vpon the ſaid produced cord beyond B, and mark this laſt prick with G. When all this is done, you may boldly ſay that the right line F C is equall to the right extenſion of $\frac{1}{2}$ of A B the ſaid aſſigned archline, & that the right line F G is equall to the right extenſion of the whole aſſigned archline A B.

CHAP. XXV.

To draw a right line equall to the right extenſion of one or two circular ſides of any aſſigned triangle with two circular ſides and a right lined baſe.

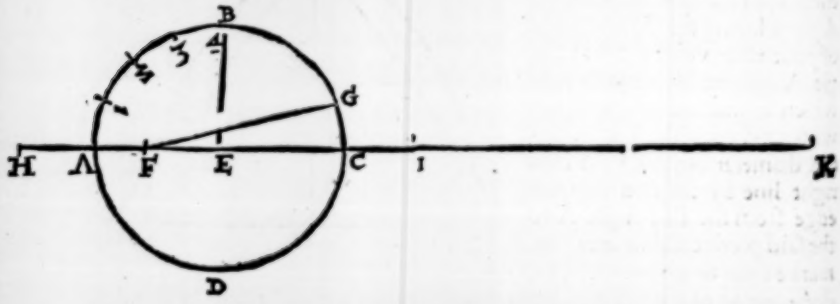
SVppoſing A E F to be an aſſigned triangle with two circular ſides and a right lined baſe, raiſe vp a perpendicular line vpon D (the middle point of the ſaid baſe) vnto the angle A, diuide the ſaid perpendicular line into two equall parts in the point G, and draw by the ſaid point G from one ſide of the ſaid triangle to the other, a right line equidiſtant to the ſaid right lined baſe E F. After this diuide the ſaid equidiſtant line into eight equall parts, produce the ſaid rightlined baſe beyond either ſide of the ſaid triangle, and laying the fiduciall edge of your ruler vpon the ſaid angle A, vpon the equall part which is marked in the figure following with 7. and vpon the produced diameter beyond F, draw a right line by that edge of your ruler from the ſaid angle A to the ſaid produced diameter, & where this line toucheth the ſaid diameter write C. Againe laying the fiducial edge of your ruler vpon the ſaid angle A, vppon that equall part which is marked in this figure with 1. and vpon the ſaid produced diameter beyond E, draw a right line by the ſaid fiduciall edge from the ſaid angle A to the ſaid produced diameter, and marke their touch with B. This done, either of the ſaid two right lines (I meane the right lines A B and A C) is equall to the right extenſion of any one of the ſaid two circular ſides of the ſaid aſſigned triangle, and A B and A C the ſaid two right lines being put togither are equall to the right extenſion of the ſaid two circular ſides A E and A F



CHAP. XXVI.

To draw by fiue ſundrie waies a right line that ſhall be equall to the right extenſion of $\frac{1}{4}$ of any aſſigned circumference, $\frac{1}{3}$ of any aſſigned circumference, or of the whole aſsigned circumference.

SVppoſing A B C D to be the aſſigned circumference, E to be the center of the ſaid circumference, and the right line A C to be the diameter thereof, produce the ſaid diameter beyond either ſide of the ſaid circumference, and diuide A B a quadrant or $\frac{1}{4}$ of the ſaid circumference into 4. equall parts. Moreouer opening your compaſſe to the iuſt length of one of thoſe equal parts, ſet one foote of the ſame compaſſe in A, and with the other foote make a pricke vpon the ſemidiameter A E. After this marking the ſaid pricke with F, remoue your compaſſe vnaltered vnto C, ſet one foote thereof vpon that point C, make a pricke with the other foote in the ſaid circumference, and marke that pricke with G. This done, draw a right line from the ſaid pricke F to the ſaid pricke G, and note that right line (I meane the right line F G) for a right line equall to the right extenſion of $\frac{1}{4}$ of the ſaid aſſigned circumference A B C D. Againe opening your compaſſe to the iuſt length of the ſaid line F G, ſet one foote of your compaſſe vnaltered in the ſaid center E, and with the other foote make two prickes vpon the ſaid produced diameter, one at H, the other at I, and take that line H I for a right line equall to the right extenſion of the aſſigned ſemicircumference A B C, or A D C. Finally put vnto the ſaid right line H I a right line equall to it, and then the right line made of the ſaid two right, equall, and vnited lines, and marked in the figure following with H K, is equall to the right extenſion of A B C D the ſaid aſſigned circumference.

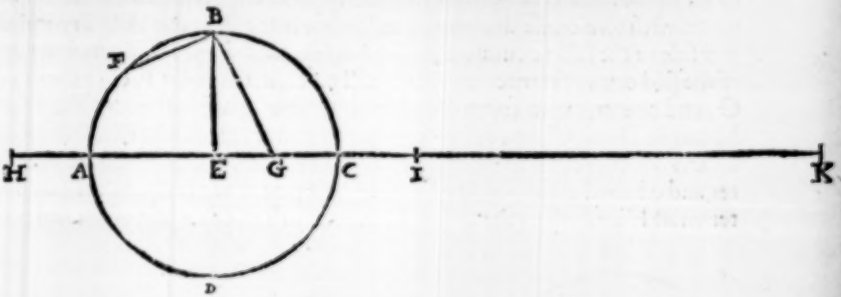


An other way.

The ſecond way.

SVppoſing A B C D to be the aſsigned circumference, E to be the center of the ſaid circumference, and A C to be the diameter therof, produce the ſaid diameter

diameter beyond either ſide of the ſaid circumference, raiſe vp vpon the ſaid center E a perpendicular line vnto the circumference, and marke their touche with B. Moreouer diuide A B a quadrant or $\frac{1}{4}$ of the ſaid circumference into two equall partes in the point F, drawe a right line from the ſaid point F, vnto the touche point B, and drawe a ſquire line from the ſaid B (now alſo one of the extremes of that line F B) vnto the ſaid diameter, and where the ſaid ſquire line toucheth the ſaid diameter, write G. After this opening your compaſſe to the length of the line C G, ſet one foote of the ſame compaſſe vnaltred in C, and with the other foote make a pricke vpon the produced diameter beyond C, and marke that pricke with I. Likewiſe remouing your compaſſe from C, ſtay one foote of the ſame compaſſe vnaltred on A, and with the other foote make an other pricke vpon the ſaid produced diameter beyond A, and marke that pricke with H. This done note the line E I, or if you will, the line E H, for a right line equall to the right extenſion of $\frac{1}{4}$ of the ſaid aſsigned circumferēce. Alſo note the line H I for a line equall to the right extenſion of the aſsigned ſemicircumference A B C, and putting a right and equall line to the ſaid right line H I, note the line made of the ſaid two right, equall and vnited lines, & marked in the figure following with H K, for a line equall to the right extenſion of A B C D the ſaid aſsigned circumference.

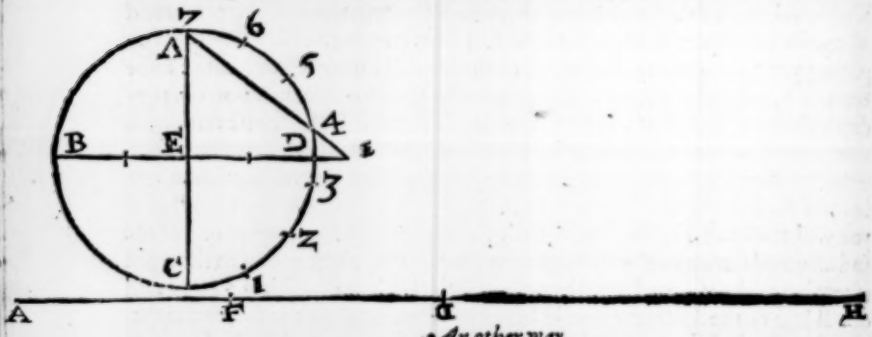


Another way.

The third way.

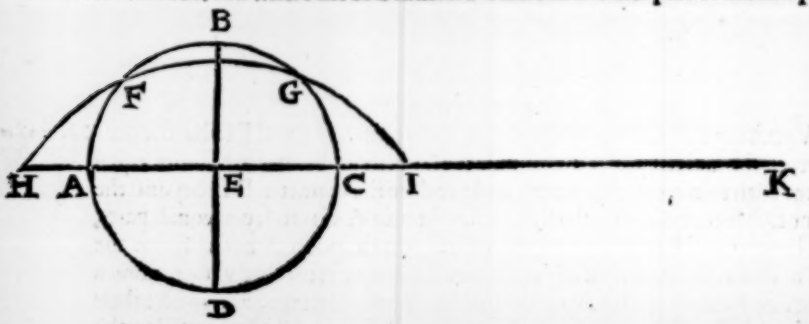
SVppoſing A B C D to be the aſsigned circumference, and E to be the center of the ſaid circumference, diuide the ſaid circumference into foure equal partes with two croſſe diameters, and produce the diameter B D beyond the point D. Moreouer diuide the ſemicircumference A C into ſeuen equall parts, and laying the fiduciall edge of your ruler vpon the point A, and alſo vpō the end of that equal part which in the figure following is marked with 4, draw a right line from the point A to the ſaid produced diameter, and marke their touch with F. This done note the ſaid line A F for a right line equall to the right extenſion of $\frac{1}{4}$ of the ſaid aſsigned circumference: and now as by putting to the right line A F an equall right line, the line made of the ſaid two equall

and vnited lines (marked in the figure following with A G) is equall to the right extenſion of the aſsigned ſemicircūference, ſo by putting an equall right line to the line A G, the line made of the ſame two equall and vnited lines (marked in the figure following with A H) is equall to the right extenſion o the ſaid aſsigned circumference A B C D.



An other way.

SVppoſing A B C D to be the aſsigned circumference, and E to be the center of the ſaid circumference, diuide the ſaid circumference into foure equal partes with two croſſe diameters, and produce the diameter A C beyond either ſide of the ſaid circumference. Alſo diuide B A, or B C a quadrant or $\frac{1}{4}$ of the ſaid circumference into two equall partes in the point F, or in the point G, and opening your compaſſe to the rightlined ſpace betweene D and F, or betweene D and G, ſet one foote of the ſame compaſſe vnaltred in the point D, and with the other foote draw an archeline ouer the ſaid produced diameter, and where the ſaid archline toucheth one part of the ſaid produced diameter write H, and where the ſaid archline toucheth an other part of the ſaid pro-



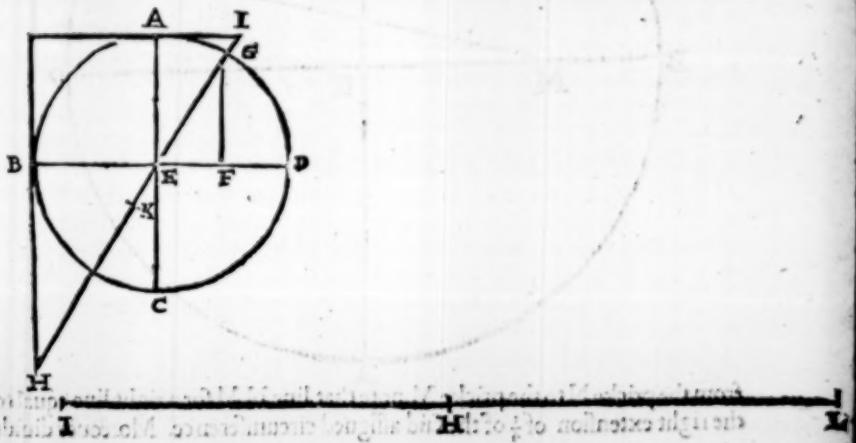
duced diameter write I. This done either of the ſaid lines (I meane the lines E H and E I) is equall to the right extenſion of $\frac{1}{4}$ of the aſsigned circumference,

the

the line H I is equall to the right extenſion of the aſsigned ſemicircumference, and an equall line being put to the ſaid line H I maketh the two equall and vnited lines (marked in the figure following with H K) equall to the ſaid aſsigned circumference A B C D.

Another way.

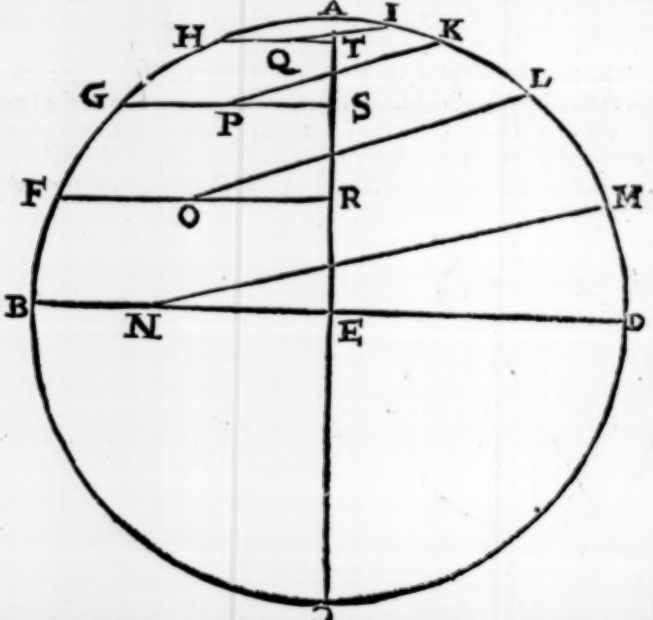
SVppoſing A B C D to be the aſsigned circumference, and E to be the center thereof, diuide the ſaid circumference into foure equall parts with two croſſe diameters A C, and B D. Alſo diuide the ſemidiameter E D into two equall parts in the point F. Moreouer raiſe vp a perpendicular line vppon the ſaid point F vnto the ſaid circumference, and where this perpendicular line (which is alſo a parallel line to the ſemidiameter A E) toucheth the circumference, write G. After this produce by B a parallel line to the diameter A C, & produce from the ſaid parallel line cloſe by A, mother parallel line to the ſaid diameter B D. Then laying the fiduciall edge of your ruler vpon the parallel line produced by A, vpon the ſaid point G, vpon the ſaid center E, and vpon the parallel line produced by B, draw a right line by the ſaid center E, and by the ſaid point G, from one of thoſe parallel lines to the other, and where this right line laſt drawne toucheth the parallel line produced by B write H, and where the ſaid right line laſt drawne toucheth the parallel line produced by A write I. This done, diuide the ſaid right line H I into two equall parts in the point K, take the line H K, or (if you will) the line K I for a line equall to the right extenſion of $\frac{1}{4}$ of the ſaid aſsigned circumference, take the line H I for a line equall to the right extenſion of the aſsigned ſemicircumference, and putting an equall line to the ſaid line H I, take the line which the ſaid 2. equall and vnited lines haue made, and is marked in the figure following with I L, for a line equall to the right extenſion of the ſaid aſsigned circumferẽce A B C D.



CHAP. XXVII.

To draw diuers right lines equall to the right extensions of diuers parts of any assigned circumference.

SVppose A B C D to be an assigned circumference diuided with two crosse diameters into foure equall parts, diuide ¼ of the said circumference into so many equall parts as you intend to draw right lines equall to the right extensions of the said circular parts. As for example, if you will draw foure diuers right lines equall to the right extensions of foure diuers parts of the said circumference, diuide A B a quadrant or ¼ of the assigned circumference into foure equall parts in the points B F G H, and from those points draw vnto the points E R S T in the semidiameter A E right lines equidistant to the semidiameter B E. This done opening your compasse to the space betweene the points B F, set one foote of the same compasse vnaltered in the point B, and with the other foote make a pricke vpon the said semidiameter B E at N. Then remoue your compasse vnaltered from B to D, stay one foote of the same compasse on D, make a pricke with the other foote vpon the said circumference at M, and hauing drawne a right line



from the pricke N to the pricke M, note that line N M for a right line equal to the right extension of ¼ of the said assigned circumference. Moreouer diuide with

with your compaſſe the right line F R into two equall parts in the point O, and without altering your compaſſe ſet one foote thereof vpon the prick M, and with the other foote make a prick vpon the ſaid circumference at L, and drawing a right line from the pricke O to the pricke L, note that line O L for a right line equal to the right extenſion of the arch F A, which is a part of the ſaid aſſigned circumference. Alſo diuide with your compaſſe the right line G S into two equal parts in the point P, and then ſetting one foote of your compaſſe vnaltered vpon the pricke L, make a pricke with the other foote vpon the ſaid circumference at K, and draw a right line from the ſaid pricke P to the ſaid pricke K, and note the ſaid right line P K for a right line equall to the right extenſion of the arch G A, which is another part of the ſaid aſſigned circumference. Likewiſe diuide with your compaſſe the right line H T into two equall parts in the point Q, and then ſetting one foote of the ſame compaſſe vnaltered vpon the point K, make a prick with the other foote vpon the ſaid circumference at I, and draw a right line from the ſaid pricke Q to the ſaid pricke I. This done, note the ſaid line Q I for a right line equall to the right extenſion of the arch H A which is alſo another part of the aſſigned circumference A B C D. In this manner you may draw diuers right lines equall to the right extenſion of diuers other parts of the ſaid aſſigned circumference.

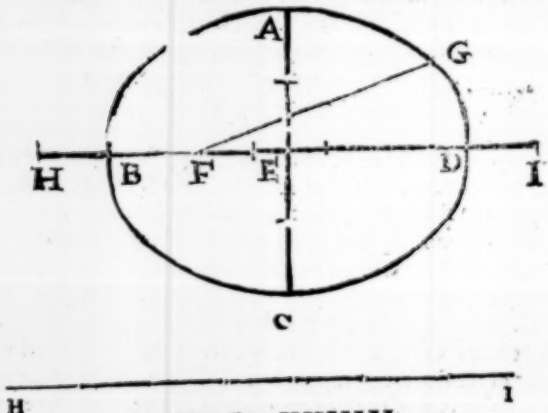
CHAP. XXVIII.

To draw by two ſundry waies a right line equal to the right extenſion of ¼ of the circumference of any aſſigned eggeforme, or to the right extenſion of the ſemicircumference of any aſſigned eggeforme, or to the right extenſion of the whole circumference of any aſſigned eggeforme.

SVPPOSING A B C D to be an aſſigned eggeforme diuided into foure equall parts with two croſſe diameters A C and B D, and E to be the center or middle point of the ſaid eggeforme, diuide the ſemidiameter B E into two equall parts in the point F, and opening your compaſſe to the length of the line E F, ſet one foote of the ſame compaſſe vnaltered vpon the point D, and with the other foot make a pricke vpon D A (which is ¼ of the ſaid eggeforme) at G. After this draw a right line from the point F to the pricke G, and take that line F G for a right line equall to the right extenſion of ¼ of the circumferēce of the ſaid aſſigned eggeforme. Moreouer produce the diameter B D beyond either end of the ſaid eggeforme, & afterwards opening your cōpaſſe to the iuſt length of the line F G, ſet one foote of the ſame compaſſe vnaltered in the ſaid center or middle point E, and with the other foot make one prick vpon the ſaid produced diameter beyond the point B, at H, and another pricke beyond the point D vpon the ſaid produced diameter at I, and note the line H I for a right line equal to the right extenſion of the ſemicircumference

of the ſaid aſsigned egforme. This done put an equall line to the ſaid line H I, and note the line made of the ſaid two vnited and equall lines, for a right line equall to the right extenſion of the whole circumference of the ſaid aſsigned egforme.

Alſo you may draw a right line equall to the right extenſion of $\frac{1}{4}$ of the circumference of any aſsigned egforme, or to the right extenſion of the ſemicircumference of any aſsigned egforme, or to the right extenſion of the whole circumference of any aſsigned egforme by this way following. Produce B D one of the diameters of the ſaid aſsigned egforme beyond either end of the ſaid egforme, diuide with your compaſſe A C (an other diameter of the ſaid egforme) into foure equall partes, and then ſetting one foote of the compaſſe vnaltred in the point B, make a pricke with the other foote vpō the ſaid produced diameter beyond B at H. After this remoue your compaſſe vnaltred from B to D, and ſtaying one foote of the ſame compaſſe on D, make a pricke with the other foote vpon the ſaid produced diameter beyond D at I. This done either of the ſaid right lines (I meane the lines E H, and E I) is equall to the right extenſion of $\frac{1}{4}$ of the circumference of the ſaid aſsigned egforme, and the right line H I is equall to the right extenſion of the ſemicircumference of the ſaid aſsigned egforme, & an equall line being put to the ſaid line H I, you may take the line made of the ſaid two vnited & equal lines, for a line equall to the right extenſion of the whole circumference of the ſaid aſsigned egforme A B C D.

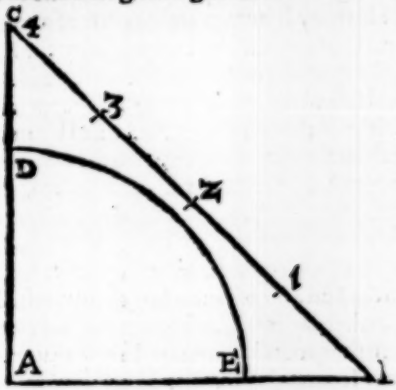


CHAP. XXVIII.

To draw an archeline equall in his right extenſion to any aſsigned right line.

SVPPOSING A B to be the aſsigned right line, raiſe vp from A (one of the extremes of the ſaid aſsigned line) a plumbe or ſquire line (marked in the figure following with A C), like in length to the ſaid line A B. Alſo draw

drawe a right line from the point C to the point B, diuide the right line laſt drawne into 4. equall partes, and then opening your compaſſe to the length of one of thoſe partes, ſet one foote of the ſame cõpaſſe vnaltred in B, and with the other foote make a pricke vpon the ſaid line B A at E. After this remoue your compaſſe vnaltred from B, and ſtaying one foote thereof on C, make a pricke with the other foote vpon the ſaid line C A at D. Againe opening your compaſſe to the length of the line A D, or A E, ſet one foote of the ſame compaſſe in A, and with the other foote draw an archeline frõ the ſaid pricke D, to the ſaid pricke E. This done the right extenſion of the ſaid archeline D E, is equall to A B the ſaid aſsigned right line.



CHAP. XXIX.

How you may ſeparate lay out & encloſe within a long ſquare one, two, or three acars of land from any other peece of ground adioyning by the helpe of three tables calculated according to a ſtatute made in the 33. yeare of the raigne of king Edward the firſt, and intituled Compoſitio vlnarum & perticarum.

DEtermine with your ſelf where you will ſeparate lay out & encloſe within a lõg ſquare one, two, or 3. acars of land frõ a peece of ground adioyning, and meaſure there in a right line vpõ the ground with a cord well ſeared with hot waxe, or with a chaine or wyer line, ſo many ſtatute pearches as you will put in a ſide of the land to be ſeparated, and in ſo doing remember that the ſaid meaſured length muſt not be longer than 160. ſtatute pearches, or ſhorter than one ſtatute pearch. This done, ſet a ſtick vpright vpõ either end of the ſaid meaſured length, & take that length for the firſt ſide of the peece of lãd to be ſeparated. Nowe to ſeparate lay out and encloſe within a long ſquare one acar of land

from a peece of groūd adioyning, peruſe the columne of the firſt table vnder this title, The meaſure of the firſt ſide, and vnder this denomination Pearches, vntill you ſhall finde there the iuſt number of pearches in the ſaid meaſured length of the firſt ſide, and then in the ſixe ſquares of the next columne right againſt the ſaid number ſo found vnder this title, The meaſure of the ſecond ſide, and vnder theſe denominations, Pearches, parts of a pearch, feete, parts of a foote, inches, parts of a inch, note diligently the number of pearches, parts of a pearch, feete, parts of a foote, inches, and parts of an inch anſwering vnto the ſaid number or meaſure of the ſaid ſide ſo found. After this meaſure againe vpon the ground in a right angle or ſquire line from one of the ends of the ſaid firſt ſide, a length of ſo many ſtatute pearches, parts of a pearch, feete, parts of a foote, inches, and parts of an inch as are expreſſed in the ſaid 6. ſquares, and ſetting a ſtick vpright vpon the end of the laſt meaſured length, take the ſame length for the ſecond ſide of the acar of land to be ſeparated. By doing thus you haue gotten 2. ſides of the ſaid acar of land, and by meaſuring in a right angle or ſquire line from the ſtick ſet vpright on the extreame or end of the ſecond ſide, a length equall, equidiſtant, and oppoſite to the firſt ſide, you ſhall alſo lay forth the third ſide of the acar of land to be ſeparated. Likewiſe by meaſuring in a right and ſquire line from the ſticke erected on the ende of the ſaid third ſide, a length equall, equidiſtant, and oppoſite to the ſaid ſecond ſide, you ſhall giue vnto the ſaid acar of land a fourth ſide, which with the ſaid other three ſides wil incloſe, lay forth, & ſeparate the ſaid one acar of land within a long ſquare from the ground adioyning. In this maner by the helpe of the ſecond table you may ſeparate, lay forth, and incloſe within a long ſquare two acars of land from any peece of ground adioyning, & by the helpe of the third table you may ſeparate, lay forth, and incloſe within a long ſquare three acars of land from any peece of ground adioyning.

A Table

A table calculated according to a ſtatute made in the 33. yeare of the raigne of king Edward the firſt and intituled Compoſitio vlnarum & perticarum: by which you may ſeparate, lay forth, & encloſe within a long ſquare one iuſt acar of land from any other peece of ground adioyning.

The meaſure of the firſt ſide.	The meaſure of the ſecond ſide.					
Perches	Perches	Parts of a perch	Feete	Parts of a foot	Inches	Parts of an inch
1	160	0	0	0	0	0
2	80	0	0	0	0	0
3	53	1/4	1	1/4	1	1/2
4	40	0	0	0	0	0
5	32	0	0	0	0	0
6	26	1/2	2	3/4	0	0
7	22	3/4	1	1/4	0	1/12
8	20	0	0	0	0	0
9	17	3/4	0	1/4	2	1/2
10	16	0	0	0	0	0
11	14	1/2	0	3/4	0	0
12	13	1/4	1	1/4	1	1/2
13	12	1/4	0	3/4	2	11/24
14	11	1/4	2	3/4	2	1/12
15	10	1/2	2	3/4	0	0
16	10	0	0	0	0	0
17	9	1/4	2	1/2	2	1/24
18	8	1/4	2	1/4	0	1/2
19	8	1/4	2	3/4	0	11/38
20	8	0	0	0	0	0
21	7	1/2	1	3/4	2	4/7
22	7	1/4	0	1/4	1	1/2
23	6	1/4	3	1/4	1	41/46
24	6	1/2	2	1/4	0	0

The meaſure of the firſt ſide.	The meaſure of the ſecond ſide.					
Perches	Perches	Parts of a perch	Feete	Parts of a foot	inches	Parts of an inch.
25	6	1/4	2	1/4	2	7/10
26	6	0	2	1/2	0	5/13
27	5	3/4	2	3/4	1	1/6
28	5	1/2	3	1/2	0	1/7
29	5	1/2	0	1/4	0	13/29
30	5	1/4	1	1/4	1	1/8
31	5	0	2	1/2	1	29/31
32	5	0	0	0	0	0
33	4	3/4	1	1/2	1	1/2
34	4	1/2	3	1/4	1	13/17
35	4	1/2	1	0	2	1/7
36	4	1/4	3	0	2	1/8
37	4	1/4	1	0	2	11/24
38	4	0	3	1/4	2	11/19
39	4	0	1	1/2	2	4/13
40	4	0	0	0	0	0
41	3	3/4	2	1/2	0	17/82
42	3	3/4	0	1/4	2	41/42
43	3	1/2	3	1/2	1	23/43
44	3	1/2	2	1/4	0	0
45	3	1/2	0	1/2	2	0
46	3	1/4	3	1/4	0	2/46
47	3	1/4	2	1/2	0	11/24
48	3	1/4	1	1/4	1	1/2

The measure of the first side.	The measure of the second side.					
Pearches	Pearches	Partes of a pearch	Feete	Partes of a foote	Inches	Partes of an inch
49	3	1/4	0	1/4	0	1/38
50	3	0	3	1/2	0	1/2
51	3	0	2	1/4	0	9/11
52	3	0	1	1/4	0	1/13
53	3	0	0	1/4	0	39/53
54	2	1/4	3	1/2	0	1/2
55	2	1/4	2	1/2	1	1/2
56	2	1/4	1	1/4	0	1/14
57	2	1/4	0	1/4	2	11/38
58	2	1/4	0	0	1	41/58
59	2	1/2	3	1/4	2	36/59
60	2	1/2	2	1/4	0	0
61	2	1/2	2	0	0	11/61
62	2	1/2	1	1/4	0	1/31
63	2	1/2	0	1/2	1	6/7
64	2	1/2	0	0	0	0
65	2	1/4	3	1/4	2	31/35
66	2	1/4	2	1/4	1	0
67	2	1/4	2	1/4	0	45/134
68	2	1/4	1	1/2	2	17/34
69	2	1/4	1	0	1	39/45
70	2	1/4	0	1/2	1	1/14
71	2	1/4	0	0	0	39/143
72	2	0	3	1/2	2	0
73	2	0	3	0	1	71/73
74	2	0	2	1/2	2	4/37
75	2	0	2	0	2	4/15
76	2	0	1	1/2	2	16/19
77	2	0	1	1/4	0	21/77

The measure of the first side.	The measure of the second side.					
Pearches	Pearches	Partes of a pearch	Feete	Partes of a foote	Inches	Partes of an inch
78	2	0	0	1/4	1	9/13
79	2	0	0	1/4	2	1/79
80	2	0	0	0	0	0
81	1	1/4	3	1/2	2	11/18
82	1	1/4	3	1/4	0	49/82
83	1	1/4	2	1/4	2	21/166
84	1	1/4	2	1/2	0	9/14
85	1	1/4	2	0	2	7/34
86	1	1/4	1	1/4	0	71/86
87	1	1/4	1	1/4	2	27/58
88	1	1/4	1	0	1	1/2
89	1	1/4	0	1/4	0	81/178
90	1	1/4	0	1/4	2	1/2
91	1	1/4	0	0	1	181/182
92	1	1/2	3	1/4	2	8/23
93	1	1/2	3	1/2	1	24/31
94	1	1/2	3	1/4	1	1/47
95	1	1/2	3	0	0	9/19
96	1	1/2	2	1/4	0	0
97	1	1/2	2	1/4	2	58/97
98	1	1/2	2	0	2	14/49
99	1	1/2	1	1/4	2	0
100	1	1/2	1	1/2	1	4/7
101	1	1/2	1	1/4	1	67/101
102	1	1/2	1	0	1	29/51
103	1	1/2	0	1/4	1	39/103
104	1	1/2	0	1/2	1	8/13
105	1	1/2	0	1/4	1	1/7
106	1	1/2	0	0	1	44/53

The measure of the fifth side.	The measure of the second side.					
Perches	Perches	Parts of a perch	Foote	Parts of a foote	Inches	Parts of an inch
107	1	1/4	4	0	1	253/576
108	1	1/4	3	1/4	0	1/6
109	1	1/4	3	1/3	1	71/108
110	1	1/4	3	1/4	1	1/3
111	1	1/4	3	0	2	67/74
112	1	1/4	2	1/4	2	1/14
113	1	1/4	2	1/3	2	197/339
114	1	1/4	2	1/3	0	11/38
115	1	1/4	2	1/4	0	41/46
116	1	1/4	2	0	1	31/58
117	1	1/4	1	1/4	2	7/26
118	1	1/4	1	1/3	2	115/178
119	1	1/4	1	1/3	0	171/238
120	1	1/4	1	1/4	1	1/4
121	1	1/4	1	0	2	7/33
122	1	1/4	1	0	0	81/132
123	1	1/4	0	1/4	1	5/82
124	1	1/4	0	1/3	1	61/62
125	1	1/4	0	1/4	2	47/70
126	1	1/4	0	1/4	0	11/14
127	1	1/4	0	0	1	241/254
128	1	1/4	0	0	0	0
129	1	0	3	1/4	2	25/43
130	1	0	3	1/4	0	9/13
131	1	0	3	1/3	1	149/196
132	1	0	3	1/3	0	0
133	1	0	3	1/4	1	26/133

The measure of the fifth side.	The measure of the second side.					
Perches	Perches	Parts of a perch	Foote	Parts of a foote	Inches	Parts of an inch
134	1	0	3	0	2	148/67
135	1	0	3	0	0	8/9
136	1	0	2	1/4	1	26/57
137	1	0	2	1/4	0	11/137
138	1	0	2	1/3	1	13/23
139	1	0	2	1/3	2	227/139
140	1	0	2	1/4	1	3/7
141	1	0	2	0	2	35/47
142	1	0	2	0	1	7/71
143	1	0	1	1/4	2	7/13
144	1	0	1	1/4	1	0
145	1	0	1	1/3	2	19/39
146	1	0	1	1/3	0	23/73
147	1	0	1	1/4	2	23/49
148	1	0	1	1/4	1	3/37
149	1	0	1	0	2	49/149
150	1	0	1	0	1	1/7
151	1	0	0	1/4	2	131/151
152	1	0	0	1/4	1	6/19
153	1	0	0	1/4	0	1/17
154	1	0	0	1/3	1	1/3
155	1	0	0	1/3	0	11/31
156	1	0	0	1/4	2	1/13
157	1	0	0	1/4	0	133/157
158	1	0	0	0	2	44/79
159	1	0	0	0	1	11/53
160	1	0	0	0	0	0

A table calculated according to a statute made in the 33. yeare of the raigne of king Edward the first, and intituled compositio ulnarum & perticarum; by which you may separate, lay forth, and enclose within a long square two acars of land from any other peece of grounde adioyning.

The measure of the first side.	The measure of the second side.					
Perches	Perches	Parts of a perch	Foote	Parts of a foote	Inches	Parts of a inch
1	320	0	0	0	0	0
2	160	0	0	0	0	0
3	106	1/2	2	1/4	0	0
4	80	0	0	0	0	0
5	64	0	0	0	0	0
6	53	1/4	1	1/4	1	1/2
7	45	1/2	3	1/2	0	2/3
8	40	0	0	0	0	0
9	35	1/2	0	1/4	2	0
10	32	0	0	0	0	0
11	29	0	1	1/2	0	0
12	26	1/2	2	1/4	0	0
13	24	1/2	1	1/4	1	11/13
14	22	1/4	1	1/4	0	1/14
15	21	1/4	1	1/4	1	1/2
16	20	0	0	0	0	0
17	18	1/4	1	0	2	12/14
18	17	1/4	0	1/4	2	1/2
19	16	1/2	1	1/2	0	9/18
20	16	0	0	0	0	0
21	15	0	3	1/4	2	1/7
22	14	1/2	0	1/4	0	0
23	13	1/4	2	1/2	2	11/46
24	13	1/4	1	1/4	1	1/2

The measure of the first side.	The measure of the second side.					
Perches	Perches	Parts of a perch	Foote	Parts of a foote	Inches	Parts of a inch
25	12	1/4	0	1/4	0	2/10
26	12	1/4	0	1/4	2	11/12
27	11	1/4	1	1/2	2	1/8
28	11	1/4	2	1/4	2	1/14
29	11	0	0	1/2	0	24/29
30	10	1/2	2	1/2	3	0
31	10	1/4	1	0	2	22/62
32	10	0	0	0	0	0
33	9	1/2	3	1/4	0	0
34	9	1/4	2	1/2	2	1/34
35	9	0	2	1/4	1	2/7
36	8	1/4	2	1/4	0	1/2
37	8	1/2	2	1/4	2	16/37
38	8	1/4	2	1/4	0	22/38
39	8	0	3	1/4	1	24/39
40	8	0	0	0	0	0
41	7	1/4	0	1/4	1	21/82
42	7	1/2	1	1/4	2	4/7
43	7	1/4	3	0	1	84/86
44	7	1/4	0	1/4	1	1/2
45	7	0	1	1/4	1	0
46	6	1/4	3	1/4	1	41/46
47	6	1/4	0	1/4	2	11/94
48	6	1/2	2	1/2	3	0

The measure of the first side	The measure of the second side.					
Perches	Perches	Parts of a perch	Foote	Parts of a foote	Inches	Parts of a inch
49	6	1/2	0	1/2	0	7/49
50	6	1/4	2	1/2	2	7/100
51	6	1/4	0	1/4	1	25/204
52	6	0	2	1/2	0	6/13
53	6	0	0	1/2	1	25/53
54	5	1/4	2	1/4	1	1/6
55	5	1/4	1	0	1	1/2
56	5	1/2	3	1/2	0	1/7
57	5	1/2	1	1/4	1	11/57
58	5	1/2	0	1/4	0	13/232
59	5	1/4	2	1/4	1	47/118
60	5	1/4	1	1/4	1	1/2
61	5	0	4	0	0	61/61
62	5	0	2	1/2	1	39/31
63	5	0	1	1/4	0	1/7
64	5	0	0	0	0	0
65	4	1/4	2	1/4	1	7/25
66	4	1/4	1	1/2	1	1/2
67	4	1/4	0	1/4	2	29/134
68	4	1/2	3	1/4	1	11/17
69	4	1/2	2	1/4	0	6/23
70	4	1/2	1	0	2	1/7
71	4	1/2	0	0	1	25/71
72	4	1/4	3	0	2	11/72
73	4	1/4	2	0	2	61/145
74	4	1/4	1	0	2	11/74
75	4	1/4	0	1/4	0	1/16
76	4	0	3	1/4	2	7/19

The measure of the first side	The measure of the second side.					
Perches	Perches	Parts of a perch	Foote	Parts of a foote	Inches	Parts of a inch
77	4	0	2	1/2	0	7/77
78	4	0	1	1/2	2	7/156
79	4	0	0	1/2	1	25/79
80	4	0	0	0	0	20
81	3	1/4	3	1/4	0	11/18
82	3	1/4	2	1/2	0	11/82
83	3	1/4	1	1/2	2	183/166
84	3	1/4	0	1/4	2	11/168
85	3	1/4	0	0	2	25/136
86	3	1/2	3	1/2	1	29/43
87	3	1/2	2	1/4	2	8/29
88	3	1/2	2	1/4	0	0
89	3	1/2	1	1/2	0	81/89
90	3	1/2	0	1/4	2	0
91	3	1/2	0	1/4	0	92/91
92	3	1/4	3	1/4	0	9/46
93	3	1/4	3	0	1	43/62
94	3	1/4	2	1/2	0	51/94
95	3	1/4	1	1/2	2	17/38
96	3	1/4	1	1/4	1	1/2
97	3	1/2	0	1/4	0	123/194
98	3	1/4	0	1/4	0	1/98
99	3	0	3	1/4	1	0
100	3	0	3	1/4	0	1/4
101	3	0	2	1/4	0	29/101
102	3	0	2	1/2	0	9/17
103	3	0	1	1/4	0	13/103
104	3	0	1	1/4	0	1/13

The measure of the fifth side.	The measure of the second side.					
Perches	Parts of a perch	Feete	Parts of a foote	Inches	Parts of an inch
105	3	0	1/4	0	1/7
106	3	0	1/4	0	29/73
107	2	3/4	3	1/4	2	139/314
108	2	3/4	3	1/2	0	1/6
109	2	1/4	3	0	0	171/314
110	2	1/4	2	1/2	1	1/3
111	2	1/4	2	0	2	33/74
112	2	1/4	1	1/4	0	3/14
113	2	1/4	1	1/4	1	47/336
114	2	1/4	0	1/4	2	11/38
115	2	1/4	0	1/2	0	21/46
116	2	1/4	0	0	1	41/78
117	2	1/2	3	1/4	1	7/11
118	2	1/2	3	1/2	2	16/19
119	2	1/2	3	0	1	53/119
120	2	1/2	2	1/4	0	0
121	2	1/2	2	1/4	1	77/134
122	2	1/2	2	0	0	21/61
123	2	1/2	1	1/2	2	5/41
124	2	1/2	1	1/4	0	20/71
125	2	1/2	0	1/4	2	23/37
126	2	1/2	0	1/2	1	6/7
127	2	1/2	0	1/4	0	174/317
128	2	1/2	0	0	0	0
129	2	1/4	3	1/4	0	17/86
130	2	1/4	3	1/4	2	33/86
131	2	1/4	3	0	2	47/362
132	2	1/4	2	1/4	1	1/3

The measure of the fifth side.	The measure of the second side.					
Perches	Parts of a perch	Feete	Parts of a foote	Inches	Parts of an inch.
133	2	1/4	2	1/2	0	237/362
134	2	1/4	2	1/4	0	45/134
135	2	1/4	1	3/4	2	1/4
136	2	1/4	1	1/2	2	22/33
137	2	1/4	1	1/4	1	169/374
138	2	1/4	1	0	1	39/46
139	2	1/4	0	3/4	1	91/314
140	2	1/4	0	1/2	1	1/14
141	2	1/4	0	1/4	0	81/314
142	2	1/4	0	0	0	22/141
143	2	0	3	1/4	2	1/11
144	2	0	3	1/2	2	0
145	2	0	3	1/4	1	28/39
146	2	0	3	0	1	71/371
147	2	0	2	3/4	2	1/49
148	2	0	2	1/2	2	4/19
149	2	0	2	1/4	2	11/149
150	2	0	2	0	2	6/19
151	2	0	1	3/4	2	91/119
152	2	0	1	1/2	2	16/19
153	2	0	1	1/2	0	3/17
154	2	0	1	1/4	0	1/7
155	2	0	1	0	0	34/71
156	2	0	0	3/4	1	3/17
157	2	0	0	1/2	1	89/113
158	2	0	0	1/4	2	1/33
159	2	0	0	0	2	34/71
160	2	0	0	0	0	0

A table calculated according to a ſtatute made in the 33. yeare of the raigne of king Edward the firſt and intituled Compoſitio vlnarum & perticarum: by which you may ſeparate, lay forth, and encloſe within a long ſquare three acars of land from any other peece of ground adioyning.

The meaſure of the firſt ſide	The meaſure of the ſecond ſide.					
Pearches	Pearches	Parts of a pearch	Feete	Parts of a foot	Inches	Parts of an inch
1	480	0	0	0	0	0
2	240	0	0	0	0	0
3	160	0	0	0	0	0
4	120	0	0	0	0	0
5	96	0	0	0	0	0
6	80	0	0	0	0	0
7	68	1/2	1	0	2	1/7
8	60	0	0	0	0	0
9	53	1/4	1	1/4	1	1/2
10	48	0	0	0	0	0
11	43	1/2	2	1/4	0	0
12	40	0	0	0	0	0
13	36	3/4	2	1/4	1	7/25
14	34	1/4	0	1/2	1	1/14
15	32	0	0	0	0	0
16	30	0	0	0	0	0
17	28	0	3	3/4	1	10/17
18	26	1/2	2	3/4	0	0
19	25	1/4	0	0	2	21/38
20	24	0	0	0	0	0
21	22	1/4	1	1/4	0	3/14
22	21	3/4	1	0	1	1/2
23	20	1/4	1	3/4	2	21/46
24	20	0	0	0	0	0

The meaſure of the firſt ſide	The meaſure of the ſecond ſide.					
Pearches	Pearches	Parts of a pearch	Feete	Parts of a foot	Inches	Parts of an inch.
25	19	0	3	1/4	0	1/7
26	18	1/4	3	1/4	2	32/36
27	17	1/4	0	1/4	2	1/2
28	17	0	2	1/4	1	3/7
29	16	1/2	0	1/4	1	7/29
30	16	0	0	0	0	0
31	15	1/4	3	1/4	1	19/62
32	15	0	0	0	0	0
33	14	1/2	0	3/4	0	0
34	14	0	1	3/4	2	5/17
35	13	1/2	3	1/2	0	3/7
36	13	1/4	1	1/4	1	1/2
37	12	3/4	3	1/2	2	11/74
38	12	1/2	2	0	2	1/19
39	12	1/4	0	3/4	2	11/38
40	12	0	0	0	0	0
41	11	1/2	3	1/4	2	3/41
42	11	1/4	2	1/4	2	7/14
43	11	0	2	1/2	2	10/43
44	10	3/4	2	1/2	1	1/2
45	10	1/2	2	1/4	0	0
46	10	1/4	3	0	0	27/46
47	10	0	3	1/2	0	6/47
48	10	0	0	0	0	0

The measure of the first side	The measure of the second side.					
Perches	Perches	Parts of a perch	Foote	Parts of a foote	Inches	Parts of an inch
49	9	1/4	0	3/4	0	9/38
50	9	1/2	1	1/2	1	4/7
51	9	1/4	2	1/2	2	7/14
52	9	0	3	1/4	0	9/13
53	9	0	0	1/4	2	11/13
54	8	1/4	2	1/4	0	1/2
55	8	1/2	3	1/4	0	0
56	8	1/2	1	0	2	1/7
57	8	1/4	2	1/4	0	11/28
58	8	1/4	0	1/4	2	7/15
59	8	0	2	0	2	59/119
60	8	0	0	0	0	0
61	7	1/4	1	1/4	2	61/133
62	7	1/2	3	1/4	2	28/31
63	7	1/2	1	1/4	2	4/7
64	7	1/2	0	0	0	0
65	7	1/4	2	0	2	17/35
66	7	1/4	0	1/4	1	1/2
67	7	0	2	1/2	2	84/67
68	7	0	0	1/4	2	11/17
69	6	1/4	3	1/4	1	41/45
70	6	1/4	1	1/4	0	1/14
71	6	1/4	0	0	2	11/143
72	6	1/2	2	1/4	0	0
73	6	1/2	1	0	2	67/73
74	6	1/4	3	1/4	1	61/74
75	6	1/4	2	1/4	2	7/10
76	6	1/4	1	0	1	1/38
77	6	0	3	1/4	1	2/7

The measure of the first side	The measure of the second side.					
Perches	Perches	Parts of a perch	Foote	Parts of a foote	Inches	Parts of an inch
78	6	0	2	1/2	0	6/13
79	6	0	1	1/4	0	1/79
80	6	0	0	0	0	0
81	5	1/4	2	1/4	1	1/6
82	5	1/4	1	1/2	2	41/82
83	5	1/4	0	1/2	0	21/166
84	5	1/2	3	1/2	0	1/7
85	5	1/2	2	1/4	2	7/17
86	5	1/2	1	1/4	1	4/43
87	5	1/2	0	1/4	0	19/39
88	5	1/4	3	1/4	1	1/2
89	5	1/4	2	1/4	1	61/178
90	5	1/4	1	1/4	1	1/2
91	5	1/4	0	1/4	1	161/183
92	5	0	3	1/2	1	1/31
93	5	0	2	1/2	1	39/31
94	5	0	1	1/4	0	1/47
95	5	0	0	1/4	1	8/19
96	5	0	0	0	0	0
97	4	1/4	3	1/4	0	17/134
98	4	1/4	2	1/4	2	39/98
99	4	1/4	1	1/2	1	1/2
100	4	1/4	0	1/4	0	9/10
101	4	1/4	0	0	0	99/101
102	4	1/2	3	1/4	1	11/17
103	4	1/2	2	1/2	1	74/103
104	4	1/2	1	1/4	1	11/13
105	4	1/2	1	0	2	1/7
106	4	1/2	0	1/4	2	11/13

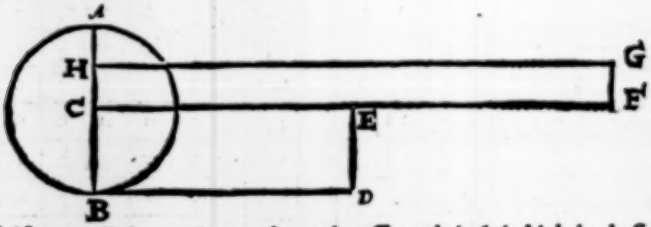
The measure of the fifth side. Perches	The measure of the second side. Perches	Partes of a perch	Foote	Partes of a foote	Inches	Partes of an inch
107	4	1/4	3	2/4	1	155/214
108	4	1/4	3	0	2	1/2
109	4	1/4	2	1/2	0	91/218
110	4	1/4	1	2/4	1	1/3
111	4	1/4	1	0	2	42/74
112	4	1/4	0	1/2	1	1/14
113	4	0	4	0	1	7/113
114	4	0	3	1/4	2	13/19
115	4	0	2	2/4	1	19/23
116	4	0	2	1/4	0	9/29
117	4	0	1	1/2	2	4/13
118	4	0	1	0	1	35/59
119	4	0	0	1/2	0	78/119
120	4	0	0	0	0	0
121	3	2/4	3	1/2	0	33/33
122	3	1/4	3	0	0	61/122
123	3	2/4	2	1/2	0	35/83
124	3	2/4	1	2/4	2	19/63
125	3	2/4	1	1/4	2	41/84
126	3	1/4	0	2/4	2	11/14
127	3	2/4	0	1/4	2	119/214
128	3	2/4	0	0	0	0
129	3	1/2	3	1/2	1	22/43
130	3	1/2	3	0	2	1/13
131	3	1/2	2	1/2	2	65/131
132	3	1/2	2	1/4	0	0
133	3	1/2	1	2/4	0	78/133

The measure of the fifth side. Perches	The measure of the second side. Perches	Partes of a perch	Foote	Partes of a foote	Inches	Partes of an inch
134	3	1/2	1	1/4	1	17/67
135	3	1/2	0	2/4	2	0
136	3	1/2	0	1/4	2	34/17
137	3	1/2	0	0	0	99/137
138	3	1/4	3	1/4	0	9/46
139	3	1/4	3	1/4	1	67/278
140	3	1/4	2	2/4	2	5/14
141	3	1/4	2	1/2	0	51/94
142	3	1/4	2	0	1	119/142
143	3	1/4	1	2/4	0	3/26
144	3	1/4	1	1/4	1	1/2
145	3	1/4	0	2/4	2	55/78
146	3	1/4	0	1/2	1	67/146
147	3	1/4	0	1/4	0	21/58
148	3	0	4	0	0	6/37
149	3	0	3	1/2	1	137/149
150	3	0	3	1/4	0	1/7
151	3	0	2	2/4	2	61/151
152	3	0	2	1/2	1	7/19
153	3	0	2	1/4	0	9/76
154	3	0	1	2/4	2	1/7
155	3	0	1	1/2	1	1/31
156	3	0	1	1/4	0	1/13
157	3	0	0	2/4	2	55/157
158	3	0	0	1/2	1	41/79
159	3	0	0	1/4	0	19/53
160	3	0	0	0	0	0

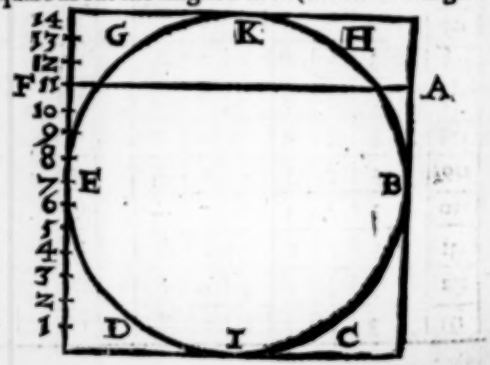
CHAP. XXXI.

To make by three ſundrie wayes a long ſquare parallelogramme equall to any aſſigned circle.

Dmitting that A B is the circle aſſigned, draw a right line equal in length to the ſemicircumference of the ſaid circle: which line in the figure next following is B D. Vpon each end of the ſaid right line B D erect a plumbe line equall in length to the ſemidiameter of the aſſigned circle. The one of the ſaid plumbe lines is marked in the figure next following with B C, and the other plumbe line is marked there with D E. After this draw another right line frō C the vpper ende of one of the ſaid plumbe lines to E the vpper ende of the other plumbe line, and then is the area of B C E D the long ſquare parallelogramme ſo made, equall to the area of the aſſigned circle. Alſo if you wil make each of the two longer ſides of the parallelogramme or long ſquare equall in length to the whole circumference of the aſſigned circle, and each of the two ſhorter ſides of the ſaid long ſquare parallelogramme equall in length to half of the ſemidiameter of that circle, you ſhall make that long ſquare parallelogramme equal to the aſſigned circle, as you may perceiue by F G H C the lōg ſquare parallelogramme here following.



Alſo if you will draw a ſquare about the aſſigned circle (which in the figure following is H C D G) & diuide one ſide of the ſquare into foureteene equall partes, and from that prick or point which endeth the eleuenth part, drawe to the oppoſite ſide a right line parallel to the other ſides, you ſhal make a long ſquare parallelogramme equall to the aſſigned circle: as you may perceaue by theſe figures



following

following, of which the long ſquare parallelogramme A C D F is equall to B E I K the aſſigned circle.

CHAP. XXXII.

To make a ſquare, or a long ſquare parallelogramme, equall to the ſector of any aſſigned circle.

IT is euident that the parallelogramme contained vnder the ſemidiameter and halfe of any portion of the circumference of a circle giuen, is equall to that ſector of the ſame circle to which the whole portion of the circumference giuen doth belong. Alſo it is manifeſt that you may vſe the halfe of the ſemidiameter and the whole portion of the circumference as ſides of the ſaid parallelogramme.

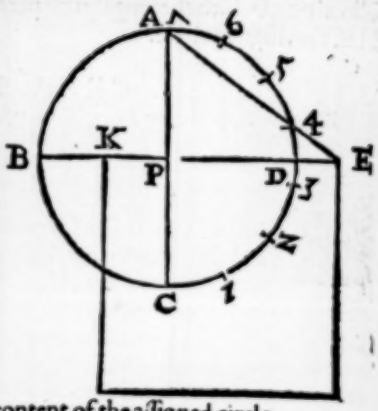
CHAP. XXXIII.

How you may make by foure ſundry wayes a ſquare equall to any aſſigned circle, & how you make a ſquare double to any aſſigned ſquare.

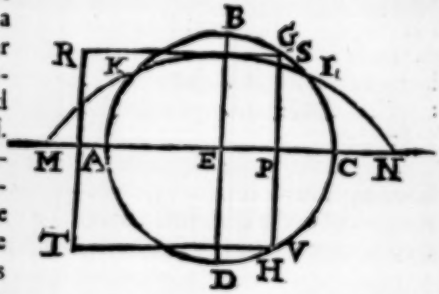
TAKE the ſquare roote of the area of the aſſigned circle for the length of one ſide of the ſquare that is equall to the ſaid aſſigned circle; and note alſo that a ſquare drawne within a circle is in proportion to that circle as ſeauen to eleuen, & that a ſquare made about a circle is in proportion to a ſquare made within that circle as foureteene to ſeauen: whereby it is manifeſt that a ſquare made about a circle is double to a ſquare made in the ſaid circle.

Alſo you may make a ſquare equall to any aſſigned circle by theſe precepts following. Diuide the aſſigned circle into foure equall partes with two diameters marked in the circle here aſſigned with A C, and B D. This done diuide the ſemicircumference of the aſſigned circle into ſeauen equall parts, and putting the fiduciall edge of your ruler to the point marked in this aſſigned circle with A, & to the equall part marked in the ſaid circle with the figure 4, draw a right line by the ſaid fiduciall edge from the ſaid point A, vntill it ſhall touch the ſaid diameter B D produced for that purpoſe beyond the ſaid diuided ſemicircumference: then hauing made a marke where the ſaid right line

toucheth the ſaid produced diameter (which marke in the circle here aſſigned is E) diuide the ſemidiameter marked in this aſſigned circle with B P, into two equall partes, and vpon the middle pricke of thoſe two partes make a marke or write a letter which here in the aſſigned circle is K. After all this make of the line lying betweene the ſaid pricke K, and the ſaid touch point E, a ſquare: for the ſaid line K E is the ſide of the deſired ſquare: that is to ſay, the ſaid line K E is the iuſt length of one of the ſides of the ſquare which in his ſuperficiall content is equall to the ſuperficiall content of the aſſigned circle.

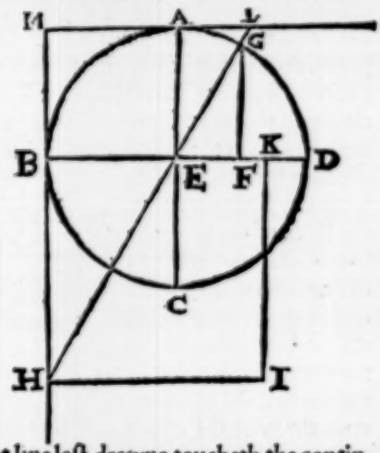


Alſo you may make a ſquare equall to any aſſigned circle by this way following. Admit that here the aſſigned circle is A B C D and that it is deuided into foure equall partes with two diameters marked with A C and B D, and that the center of the ſaid circle is marked with E. Now produce the ſaid diameter A C ouer the circumference on either ſide, and deuide B A, or (if you will) B C a quadrant or $\frac{1}{4}$ part of the ſaid aſſigned circle, into two equall parts, and vpon the middle point of the ſame two parts in the quadrant B A, write K, or vpon the middle point of the two parts in the quadrant B C, write L. Then opening your compaſſe to the rightlined ſpace betwene the ſaid point D and the ſaid point K, or to the rightlined ſpace betweene the ſaid point D, and the ſaid point L, ſet faſt one foote of the compaſſe vnaltered in the ſaid point D, and with the other foot thereof draw an arch line from a point in the produced diameter here marked with M, vnto an other point in the ſaid produced diameter here marked with N. After all this diuide the ſemidiameter (here marked with E C) into 2. equal parts, & make a marke vpō the midle point of the ſame two parts, which marke in this aſſigned circle is P. This done, draw from a part of the circumferēce of this aſſigned circle to another part thereof, a perpendicular line ouer that point here marked with P, and then writing a letter or figure at each



end of the ſaid perpendicular line which muſt be alſo a parallel line to the ſaid diameter B D, take that perpendicular and parallel line marked in this aſſigned circle with G H, for the iuſt length of one ſide of the ſquare which is equall to the aſſigned circle. As for example in the former figure the ſquare T R S V being made vpon the line T V which is like in length to the ſaid perpendicular and parallel line G H, is equall to A B C D the aſſigned circle.

Alſo a ſquare may be made equall to any circle aſſigned by this way following. Suppoſe that the circle aſſigned is A B C D, and that the center thereof is E, and that it is deuided into foure equall parts with two diameters A C, and B D. Then diuide the ſemidiameter E D into two equall parts in the point F, and erect to the circumference of the aſſigned circle a perpendicular line vpon the ſaid point F, which perpendicular line muſt alſo be a parallel line to the ſemidiameter A E. After this note where the ſaid perpendicular and parallel line toucheth the circumference, and marking their touch with G, produce a contingent line that may eaſily be wiped out, ouer the point B, and let the ſame contingent line be a parallel line vnto the diameter A C. This done, draw from M one of the ends of the ſaid produced line, another contingent line that may be eaſily wiped out, ouer the point A, & let this contingent line laſt drawne be a parallel line to the diameter B D. Now laying the fiduciall edge of your ruler vpon the contingēt line drawne ouer the point A, and cloſe vnto the point G, & center E, draw a right line by the ſaid fiduciall edge from the contingent line extended ouer the point A, vnto the other contingent line that hath bene produced ouer the point B, and where this right line laſt drawn toucheth the line produced ouer the point B write H; & where the ſaid right line laſt drawne toucheth the contingent line produced ouer the point A, write L, & then take the right line betweene B and H for the iuſt length of one ſide of the ſquare that is equall to the ſaid aſſigned circle. For if a ſquare be made vpon a line like in length to the ſaid right line B H, it will without doubt be equall to A B C D the circle here aſſigned.

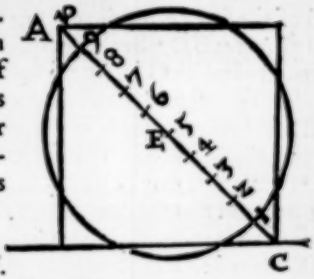


CHAP. XXXIIII.

To make a circle equall to any aſſigned ſquare.

DRaw a right line from one of the angles in the ſquare aſſigned to the oppoſite angle in that ſquare, and diuide the ſaid line marked in the figure

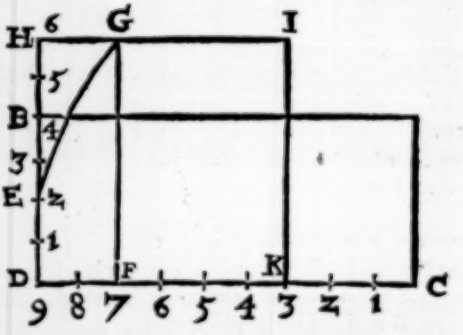
following with A C into ten equall parts. Thē opening your compaſſe to the length in foure of thoſe parts, ſet one foote therof in the middes of that diagonall line, that is to ſay, on the point E, draw with the other foote of the ſame compaſſe vnaltered a circle, and note that the circle ſo drawne is equall to the ſaid aſſigned ſquare.



CHAP. XXXV.

To make by two ſundrie waies a ſquare equall to any aſſigned long ſquare.

SVppoſing A B C D to be the aſſigned long ſquare, diuide B D one of his ſhorter ſides into two equall parts in the point E, and then opening your compaſſe to the rightlined diſtance betweene the point D, & the point E, ſet faſt one foote of the compaſſe vnaltered vpon the point D, and with the other foote thereof make a point in the line D C, and marke that point with F. After this erect vpon the ſaid point F a plumbe line, and then opening your compaſſe to the rightlined diſtance betweene the point C, and the point E, ſet faſt one foote of your compaſſe vnaltered in the point C, and with the other foote thereof draw an arch line from the point E vnto the ſaid plumbe line, and where the ſaide arche line and plumbe line ſhall touch, write G. This done note the lēgth of the ſaid plūb line F G for the iuſt lēgth of one ſide of the ſquare that is equall to the ſaid aſſigned long ſquare. As for example in this figure the ſquare D H I K made vpon the line D H (which is like in lēgth to the ſaid plumbe line F G, is equall to A B C D the aſſigned long ſquare: and for proofe thereof, if you will meaſure ſeuerally (as you haue bene taught) the area of A B C D the aſſigned long ſquare, and the area of D H I K the ſquare made in the figure following, according to the arte taught in the twelfth & thirteenth chapters of the ſecōd booke of this treatiſe, you ſhall finde that the area of the ſaid ſquare D H I K will be equall to the area of the ſaid aſſigned long ſquare A B C D.

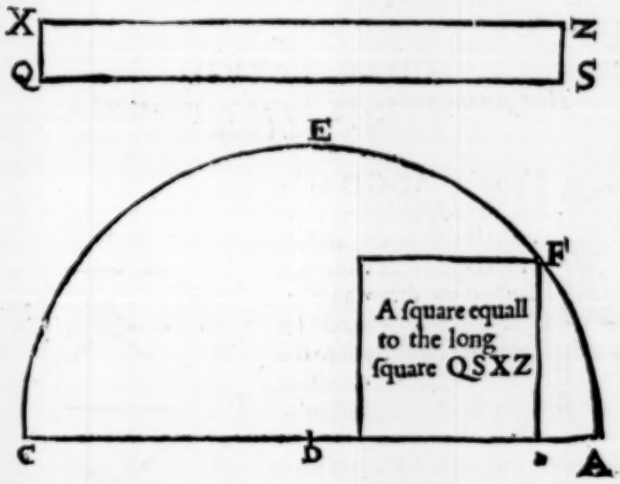


Alſo you may make a ſquare equall to any aſſigned long ſquare by this

way following. Suppoſing Q S X Z to be the aſſigned long ſquare, meaſure (as you haue bene taught) the length of X Q one of the ſhorter ſides of the ſaid long ſquare. Likewiſe meaſure the length of Q S, one of the longer ſides of the ſaid long ſquare, and ioyne togither thoſe two lengthes: that is to ſay, draw a right line equall in length to both thoſe lengthes, as is the right line A B C here vnder drawne: for the length of the ſide X Q is in that part of the ſaid right line which is marked with A B, and the length of the ſide Q S is in the other part of the ſaid right line marked with B C. This done diuide the ſaid right line A C into two equall parts in the point D, and then opening your compaſſe to the ſpace betweene A D or D C, ſet one foote of the compaſſe vnaltered in the ſaid point D, and with the other foote thereof draw the ſemicircle A E C. After all this erect vpon the point B a perpendicular line vnto the circumference of the ſaid ſemicircle, and where the ſaid perpendicular line toucheth the ſaid circumference, write F, and take the length of the ſaid perpendicular line B F, for the iuſt length of one of the ſides of the ſquare which is equall to the ſaid aſſigned long ſquare Q S X Z.

Here by occaſion of that which hath bene taught in this chapter I can not omit to tell you that making each equall ſide of a ſquare peece of ground to containe in length 12. pearches $\frac{1}{2}$ pearch, 2. foot $\frac{1}{2}$ of a foot, 2. inches and $\frac{11}{21}$ of an inch, you may alſo ſeparate and lay out enclоſe within the ſame ſquare one ſtatute acar of land from any other peece of ground adioyning.

Note that a neare ſquare of an acar of land is 12. pearches $\frac{1}{2}$ pearch, two foote, $\frac{1}{4}$ of a foote, two inches & $\frac{11}{21}$ of an inche.



CHAP. XXXVI.

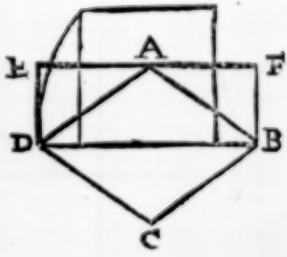
To make a rhombus equall to any assigned circle.

ADmitting A B C D to be the assigned circle, diuide it into 4. equall parts with two diameters A C, and B D, and produce the diameter B D ouer the circumference on either side. This done, diuide the said circumference into 14. equall parts, and then putting the fiduciall edge of your ruler vnto the point A, and to the equall part marked in the saide circumference with 3. produce a right line by the saide fiduciall edge from the point A vnto the said produced diameter, and where the said right line so produced toucheth the produced diameter write E. After this putting the fiducial edge of your ruler to the said point A, and to the equall part marked in the said circumference with 11, produce another right line by the said fiducial edge from the point A, vnto the said produced diameter, and where this right line last produced toucheth the said produced diameter, write F. Moreouer draw a right line by the fiduciall edge of your ruler from the point F vnto the point C, and from the said point C draw by the said fiduciall edge another right line to the point E. When all this is done, you haue made a rhombus (marked in the figure next following with A E C F) that is equal to A B C D the assigned circle.

CHAP. XXXVII.

How you may make a long square, or a square equall to any assigned rhombus.

SVpposing A B C D to be the assigned rhombus, drawe a right line from the angle B to the angle D, & when you haue so done, drawe another right line close by A, and let it be a parallel line and of like length to the right line B D. Then erecting vpon either ende of the said line B D a perpendicular line vnto the said parallel line marked in the figure following with E F, you haue made a long square that is equall vnto the said assigned rhombus.



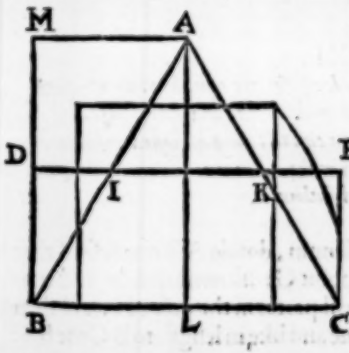
After

After a long ſquare is in this ſort made equall to an aſſigned rhombus, you may make a ſquare equall to the ſaid aſſigned rhombus, if you will make the ſquare (as you haue bene taught in the 34. chapter of this third booke) equall to the ſaid long ſquare.

CHAP. XXXVIII

How you may make by two ſundry wayes a long ſquare equall vnto any aſſigned equilater triangle, and how you may make a ſquare equall vnto any aſſigned equilater triangle.

SVPPOSING A B C to be the aſſigned equilater triangle, diuide A B one ſide of the ſaid triangle into two equall parts in the point I, likewiſe diuide A C another ſide of the ſaid triangle into two equall partes in the point K, and then drawe a right line by the ſaid points I K, and let this right line be a parallel line, and like in length to B C the baſe or third ſide of the ſaid aſſigned triangle. All this being done, erect a perpendicular line vpon either end of the ſaid baſe or ſide B C vnto the ſaid parallel line marked here with D E, and by ſo doing you haue made a long ſquare (marked in the figure following with B C D E) that is equall to the ſaide aſſigned triangle A B C. Alſo you may make a long ſquare equall to any aſſigned equilater triangle by this way following. Diuide B C the baſe of the aſſigned triangle into two equall parts in the point L, and erect vppon that point L a perpendicular line vnto the angle A: then opening your compaſſe to the iuſt length of the ſaid perpendicular line A L, ſet one foot of the ſame compaſſe vnaltred in B, and with the other foot make an arch or bow line ouer B. This done, open your cõpaſſe to the iuſt length of half the ſaid baſe, or (which is all one) to the length of the line L C, or to the length of the line L B, and ſtaying one foote of the cõpaſſe vnaltred in A, drawe with the other foot an arch or bow line croſſe the firſt arch line. Now from the pointe in which the ſaid two arch or bow lines do croſſe, draw a right line to A, and frõ the ſaide croſſe point marked in the figure following with M, drawe a right line to B. When all this is done you haue made a long ſquare (marked in the figure following with A M B L) that is equal to the ſaid aſſigned equilater triangle A B C.

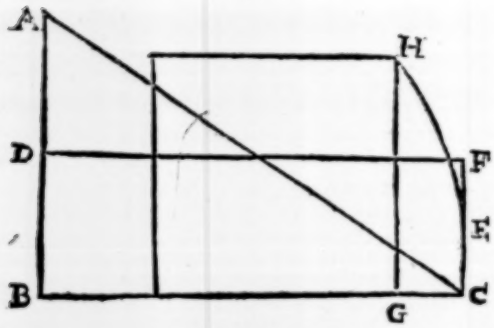


After you haue made by any of theſe two wayes a lõg ſquare equall to the aſſigned equilater triangle, you may make a ſquare equall to the ſaid aſſigned equilater triãgle, if you will make the ſquare (as you haue bene taught in the 34. chapter of this third book) equal to the ſaid long ſquare B C D E, or to the ſaid lõg ſquare A M B L.

CHAP. XXXIX.

Howe you may make a long ſquare equall to any aſſigned orthogonium or right angled triangle, and how you may make a ſquare equall to any aſsigned orthogonium or right angled triangle.

SVppoſing A B C to be an aſſigned orthogonium or right angled triangle, diuide A B one ſide of the ſaid triangle into two equall parts in the point D, and draw from the ſaid point D, a parallell line and like in length to B C another ſide of the ſaid triangle. This done, erect to the ſaid parallel line D F vpō C one end of the ſaid ſide B C a perpēdicular line, & then you haue made a lōg ſquare that is equal to A B C the aſſigned orthogonium or rightangled triangle. And now if you will make (as you haue bene taught in the 34. chapter of this third booke) a ſquare equall to the ſaid long ſquare D E B C, the ſquare ſo made will be alſo equall to the ſaid aſſigned orthogonium or right-angled triangle A B C.



CHAP. XL.

How you may make by two ſundry wayes a long ſquare equall to any aſsigned ſcalenum, how you may make a long ſquare double to any aſsigned ſcalenum, how you may make a ſquare equall to any aſsigned ſcalenum, and how you may make a ſquare double to any aſsigned ſcalenum.

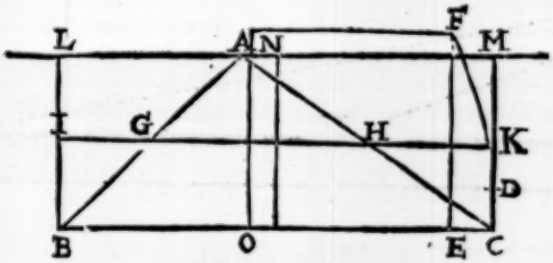
SVppoſing A B C to be an aſſigned ſcalenum, diuide A B one ſide of that ſcalenum into two equall parts in the point G: likewiſe diuide A C another ſide of the ſaid ſcalenum into two equall partes in the point H, and then draw by the ſaid points G H, a parallel line and like in length to B C the baſe

or

or third ſide of the ſaid ſcalenum. This done, raiſe vp vpon either ende of the ſaid ſide B C, a perpendicular line vnto the ſaid parallel line, and by ſo doing you haue made a long ſquare marked in the figure following with I K B C) that is equall to the ſaid aſſigned ſcalenum A B C.

Alſo if you will make a long ſquare vpon the baſe of the aſſigned ſcalenum and encloſe the ſaid ſcalenum within the ſaid long ſquare, the half of that long ſquare (marked in the figure following with L N B O, and with N M O C) is equall to the aſſigned ſcalenum, and the whole long ſquare marked in the figure following with L M B C is double to the ſaid aſſigned ſcalenum.

Now to make a ſquare equall to the ſaid aſſigned ſcalenum, you muſt make (as you haue bene taught in the 34. chapter of this third booke) a ſquare equall to the ſaid long ſquare I K B C, and ſo the ſaid ſquare will be alſo equall to the ſaid aſſigned ſcalenum A B C. But if you will make a ſquare equall to the ſaid long ſquare L M B C the ſaide ſquare will be double to the aſſigned ſcalenum.



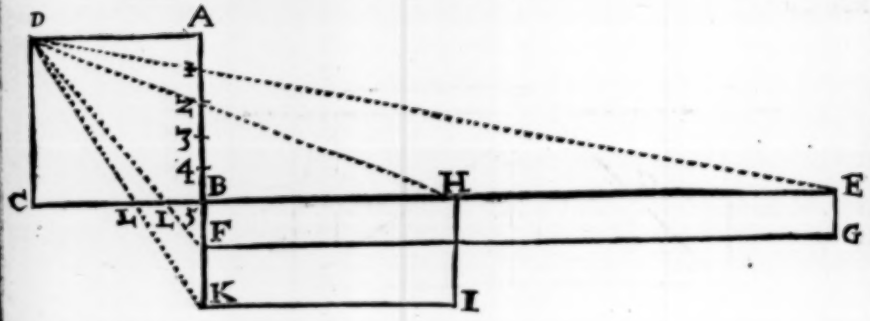
CHAP. XLI.

To make a broad or narrow long ſquare equall to any aſſigned ſquare.

SVPPOSING A B C D to be the aſſigned ſquare, produce C B one ſide thereof, and diuide A B an other ſide of the ſaid ſquare, into three, foure or fiue equall partes beginning at A. Then ſetting one foote of your compaſſe vpō A, ſtretch forth the other foot vnto one of thoſe equall partes which you will, and note that the more farther the ſaid equall part is from the angle A, the length of the deſired long ſquare will be the more ſhorter. After this ſet one foote of the ſame compaſſe vnaltred in B, and with the other foote make a pricke in the ſaid ſide B C, and marke that pricke with L. This done lay the fiduciall edge of your ruler vpon D an angle of the ſaid aſſigned ſquare, and vpon that equal part to which from A, your compaſſe was opened, and where the ſayd fiduciall edge toucheth the ſaid produced line, write E, and note the length of the line E B for the iuſt length of one of the longer ſides of the deſi-

red long ſquare. Moreouer produce A B the ſide of the ſaid aſſigned ſquare, and putting the fiduciall edge of your ruler cloſe vnto the ſaid angle D, and to the ſaid pricke marked with L, write F where the ſaid fiduciall edge toucheth the line laſt produced, and note the length of the line B F for the iuſt length of one of the ſhorter ſides of the ſaid deſired long ſquare. Then draw from F a parallel line and like in length to B E, and marke that parallel line with F G. Alſo drawe from G to E a right line equidiſtant to F B, and by ſo doing you haue made E B G F a long ſquare equall to the aſſigned ſquare A B C D.

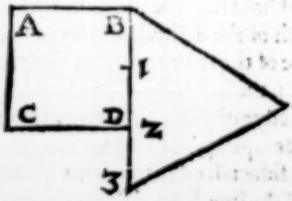
Now noting well what I haue taught you in this chapter, you may make a more ſhorter long ſquare than is the ſaid E B G F, equall to the ſaid aſſigned ſquare. As for example in the figure following H B I K is a more ſhorter long ſquare than E B G F, and this notwithſtanding it is equall to the ſaid aſſigned ſquare A B C D.



CHAP. XLII.

To make an equilater triangle equall to any aſſigned ſquare.

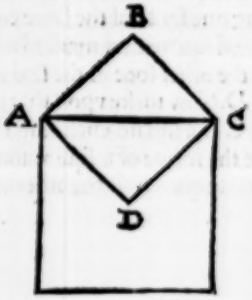
SVPPOSING A B C D to be the aſſigned ſquare, diuide any one ſide therof into two equal parts, and make each ſide of the deſired equilater triangle equall in length to three of thoſe equall partes. This done, you haue made an equilater triangle equall to the ſayd aſſigned ſquare A B C D.



CHAP. XLIII.

To make a ſquare double to any aſſigned ſquare.

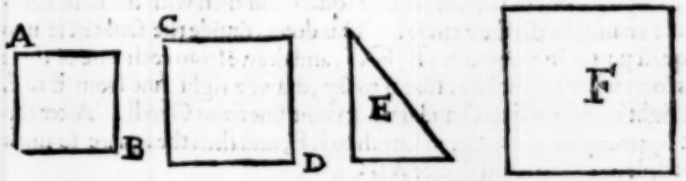
SVPPOSING A B C D to be the aſſigned ſquare, draw a right line from any one angle of that ſquare to the oppoſite angle, and vpon that line or any other line of like lēgth, make (as you haue been taught in the 4. chapt. of this third booke) a ſquare. This done the ſquare ſo made is double to the ſaid aſſigned ſquare A B C D.



CHAP. XLIIII.

How you may make a ſquare equall to any two aſſigned ſquares.

SVPPOSING A B, and C D, to be the two aſſigned ſquares, draw a right line equall in length to a ſide of one of the ſaid ſquares, and vpon one end of it raiſe a perpendicular line equall in length to a ſide of the other ſquare. Then drawing an hipothenuſall or ſlope line betweene thoſe two lines, make therof a right angled triangle marked here with E. This done make vpō that hipothenuſall or ſlope line, or vpon an other line of like length a ſquare: and note that the ſquare ſo made here marked with F, is equall to the other two aſsigned ſquares.

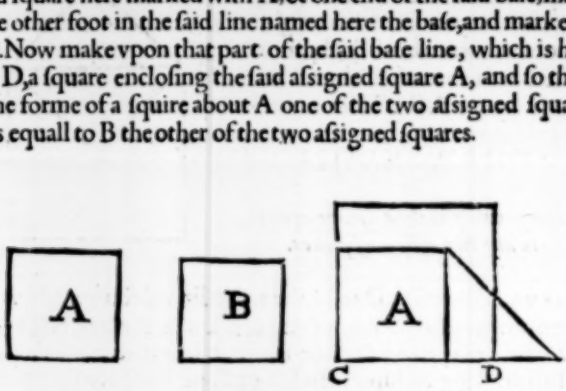


CHAP. XLV.

When any two ſquares are aſsigned, how you may make a ſquire about the one ſquare, that ſhall be equall to the other ſquare.

SVPPOSING A and B to bee the two aſsigned ſquares, determine with your ſelfe about which ſquare you will make the ſquire, and produce one ſide of that ſquare according to the meaſure of the ſide of the other ſquare: which line may here be called the baſe. This done you haue a right angle made

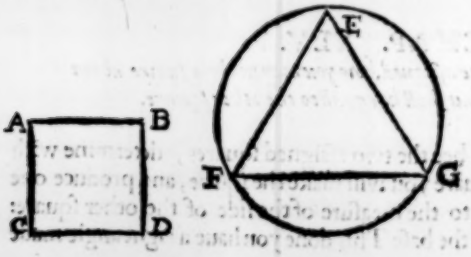
on the ſaid baſe by an other ſide of the ſaid ſquare here marked with A, and therefore turne that (as you haue been taught in the 43. chapter of this third booke) into a rightangled triangle, by drawing an hipothenuſall or ſlope line betweene thoſe two lines which make the ſaid right angle. After this open your compaſſe to the length of the ſaid hipothenuſall or ſlope line, and then ſetting one foote of the ſame compaſſe vnaltred in C the fartheſt angle of that aſsigned ſquare here marked with A, & one end of the ſaid baſe, make a pricke with the other foot in the ſaid line named here the baſe, and marke that pricke with D. Now make vpon that part of the ſaid baſe line, which is here marked with C D, a ſquare encloſing the ſaid aſsigned ſquare A, and ſo there will appeare the forme of a ſquire about A one of the two aſsigned ſquares: which ſquire is equall to B the other of the two aſsigned ſquares.



CHAP. XLVI.

To triple any aſsigned ſquare.

SVPPOSING A B C D to be the aſsigned ſquare, open your compaſſe to the length of one of the ſides of that ſquare, and then with the ſame compaſſe vnaltred deſcribe a circle. This done, diuide the ſaid circle into three equall partes in the pointes E, F, G, and drawe from each one of thoſe pointes to an other a right line: that is to ſay, drawe a right line from E to F, draw a right line from F to G, and draw a right line from G to E. After this make a ſquare vpon a line like in length to E F, and then the ſquare ſo made will be triple to the aſsigned ſquare A B C D.



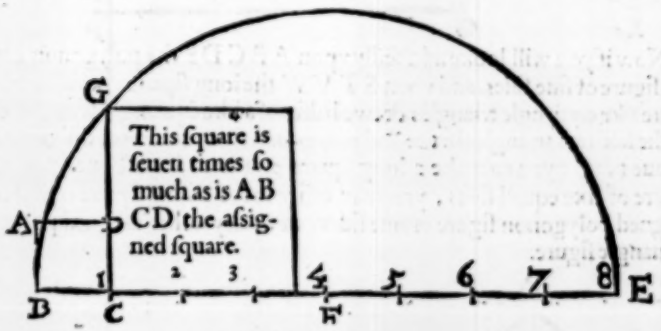
This ſquare is triple to the aſsigned ſquare A B C D.

CHAP.

CHAP. XLVII.

To make a ſquare that ſhall containe ſeuen times ſo much as any aſsigned ſquare.

SVppoſing A B C D to be the aſsigned ſquare, produce B C a ſide of that ſquare vntill it bee eight tymes ſo long as one equall ſide of the ſaid ſquare is, and at the ende of the ſaid produced ſide write E. This done, diuide B E the produced ſide or line into two equall partes in the point F, and thē opening your compaſſe to the length of B F, or E F (one halfe of the length of the ſaid produced line B E) ſet one foote of the ſame compaſſe vnaltred in the point F, and with the other foote deſcribe a ſemicircle from B to E. After this produce C D an other ſide of the ſaid aſsigned ſquare vntill it ſhall touch the circumference of the ſaid ſemicircle, and on the ſaid contingēt point write G. Now vpon the ſaid produced line or ſide C G, or vpon any other right line of like length, make a ſquare, and then the ſquare ſo made will be ſeuen times ſo much as is the ſaid aſsigned ſquare A B C D.



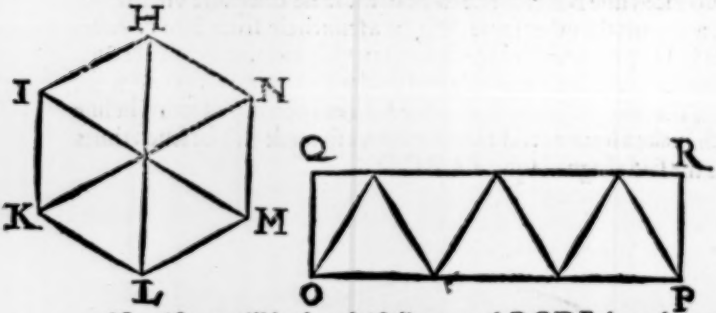
CHAP. XLVIII.

How you may make a long ſquare equall to any aſſigned poligonon equiangle figure, and how you may make a ſquare equall to any aſsigned poligonon equiangle figure.

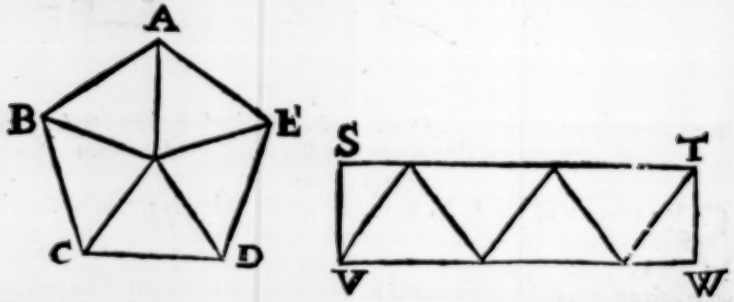
SVppoſing HIK L M N to be an aſſigned polygonon equiangle figure of ſixe ſides, draw a diameter from the angle H, to the angle L. Likewiſe draw a diameter from the angle I, to the angle M, and draw alſo a diameter from the angle K, to the angle N. Now the ſaid poligonon equiangle figure of ſixe ſides being brought by the ſaide three diameters into ſixe equilater and equiangle triangles, draw a right line apart

Note that euerie angle of an equilater triangle cõtaineth ⅔ parts of a right angle.

from the ſaid polygonon figure, and let this right line be in length once and a halfe ſo much as is one of the ſaid diameters. After this make vpon the ſaid right line here marked with O P, three equilater triangles equall vnto three of the triangles in the ſaid poligonon figure, and hauing drawne by the toppes of the three triangles laſt made a line equidiſtant, and like in length to the ſaid right line O P, erect vpon either end of the ſaid line O P a plumbe line vnto the ſaid equidiſtant line here marked with Q R. Al this being done, you haue made a long ſquare (marked here with O P Q R) equall to the ſaid aſſigned polygonon equiangle and equilater figure of ſixe ſides.



Now if you will looke aduiſedly vpon A B C D E the polygonon equiangle figure of fiue ſides, and vpon S T V W the long ſquare (which encloſeth foure like equiangle triangles & two halfes of a like equiangle triangle (equall to the ſaid fiue triangles in the ſaid polygonon figure, and note diligently how I haue taught you to make a long ſquare equall to any aſſigned polygonon figure of ſixe equall ſides, you may eaſily make a long ſquare equall to any aſſigned polygonon figure of fiue ſides, or to any other aſſigned polygonon equiangle figure.



When a ſquare ſhall be made equall to H I K L M N the ſaid aſſigned polygonon

lygonon figure of ſixe equall ſides, you muſt make (as you haue bene taughe in the 34 chapter of this third book) the deſired ſquare equall to the ſaid long ſquare O P Q R, and then the ſquare ſo made will be alſo equal to H I K L M N the aſſigned polygonon figure of ſixe ſides. Likewiſe if you will make a ſquare equall to any other aſſigned polygonon equiangle and equilater figure you muſt make the deſired ſquare (by the art taught in the ſaid 34. Chapter of this third booke) equall to a long ſquare that hath (by the doctrine taught in this chapter) bene made equall to the aſſigned poligonon equiangle and equilater figure, and by ſo doing you ſhall obtaine your deſire.

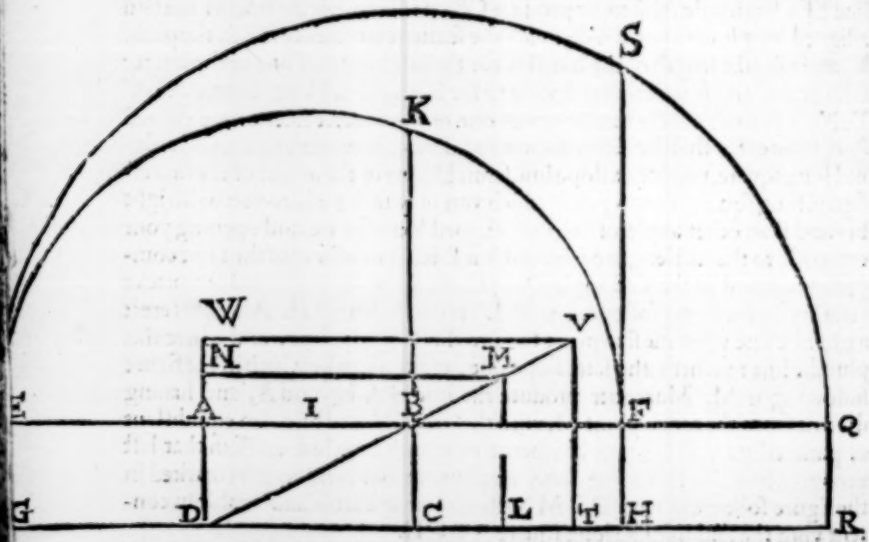
CHAP. XLIX.

To make a long ſquare double or triple to any aſſigned long ſquare.

SVPPOSING A B C D to be the aſſigned long ſquare, vnite a like and equall long ſquare vnto either ſide thereof, and marke the angles of the long ſquare which the ſaid three like and equall long ſquares vnited together haue made, with foure diuers figures or letters, which in the figure following are E F G H. This done diuide E F the vppermoſt ſide of the ſaid long ſquare E F G H, into two equall parts in the point I, and then opening your compaſſe to the length of the line E I or I F, ſet one foote of the ſame compaſſe vnaltered in the point I, and with the other foote deſcribe ouer the line E F a ſemicircle. Moreouer produce C B one of the ſhorter ſides of the ſaid aſſigned long ſquare vntill it do touch the ſemicircumference E F in the point K, and take the length of the line B K for the iuſt length of one of the longer ſides of the long ſquare that is double to the ſaid aſſigned long ſquare A B C D. Now to finde out the due length of one of the ſhorter ſides of the deſired long ſquare that ſhall be like in forme and double in content to the ſaid aſſigned long ſquare, produce a ſlope line from D (one of the angles of the ſaid aſſigned long ſquare) vnto a point (which you may make where you will) right beyond B an other angle of the ſaid aſſigned long ſquare, and opening your compaſſe to the iuſt length of the ſaid line B K, ſet one foote of the ſame compaſſe vnaltered in the ſaid angle D, and with the other foote make a pricke (marked in the figure following with L) vpon the line D H. After this erect a plumbe line vpon the ſaid prick L, vnto the ſaid ſlope line, and where this plumbe line toucheth the ſaid ſlope line, make a marke which in the figure following is M. Moreouer produce the line D A beyond A, and hauing drawne from the touch point M, vnto the laſt produced line, an equidiſtant or parallel line to D L, write N where this equidiſtant line croſſeth that laſt produced line. All this being done, you haue made a long ſquare (marked in the figure following with D L M N) that is like in forme, and double in content vnto the ſaid aſſigned long ſquare A B C D.

But if you will make a long ſquare like in forme and triple in content to

any aſſigned long ſquare, ioyne to one of the ſhorter ſides of the aſſigned long ſquare a like and equall long ſquare, and ioyne to the other ſhorter ſide of the aſſigned long ſquare two ſuch like and equall long ſquares vnited togither. Then marke the angles of the long ſquare which the ſaid foure like and equal long ſquares vnited togither haue made, with foure diuers figures or letters, which in the figure following are E G Q R, & afterwards opening your compaſſe to the length of the line that is marked in the figure following with E B (that is to ſay) to half the length of one of the longer ſides of that long ſquare which the ſaid foure like and equall long ſquares vnited togither haue made) ſet one foote of the ſame compaſſe vnaltered in the point marked in the figure following with B, and with the other foote of the ſame compaſſe deſcribe ouer the line E Q a ſemicircle. This done produce the line marked in the figure following with H F, vnto E Q the ſemicircumference laſt drawne, and where this produced line toucheth the ſaid ſemicircumference, make a marke which in the figure following is S. Now the ſaid line F S is the true length of one of the longer ſides of the ſaid long ſquare, that is like in forme and triple in content to the ſaid aſſigned long ſquare A B C D: wherefore opening your compaſſe to the exact length of the ſaid line F S, ſet one foote of the ſame compaſſe vnaltered in the ſaid angle D, and with the other foote make a prick vpon the ſaid line D H: which pricke in the figure following is marked with T.



Vpon this pricke T erect a plumbe line vnto the ſaid ſlope line, and where this

this plumbe line toucheth the ſaid ſlope line, make a marke which in the figure following is V. After all this produce the line that is marked in the figure following with D N, and drawing from the ſaid touch point V vnto the laſt produced line, a parallel and equidiſtant line to the ſaid line D T, write W (or what other letter or figure you will) vpon the angle that the ſaid parallel line and produced line haue made, and then you haue finiſhed a long ſquare (marked in this figure with D T V W) that is like in forme, and triple in content to the ſaid aſſigned long ſquare A B C D. Alſo by the art taught in this chapter you may increaſe the area of a long ſquare ſo much as you will aboue the area of any aſſigned long ſquare.

CHAP. L.

Vpon a right line geuen, and to a point in it geuen, to make a rectiline angle equall to a rectiline angle geuen.

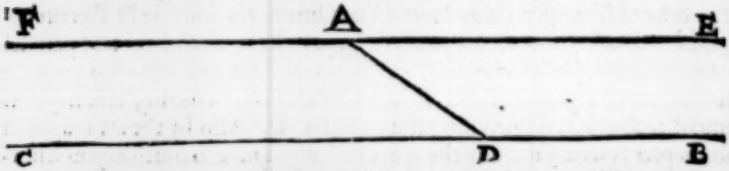
SVpposing A B to be the right line geuen, A to bee in it the point geuen, and C D E to be the rectiline angle geuen, open your compaſſe to what wideneſſe you will ſo that it do not exceede the lēgth of the ſhorteſt line that incloſeth the rectiline angle geuen, and thē putting one foote of the ſame compaſſe vnaltered vpon D make a pricke with the other foote thereof on the line D C and marke that pricke with F. Likewiſe keeping one foot of the ſame compaſſe vnaltered vpon D, make an other pricke with the other foote therof on the line D E, and marke this pricke laſt made with G. Againe ſetting one foote of the ſame compaſſe vnaltered on A the ſaid point geuen, draw with the other foote therof frō A B the line geuen an archline (marked here with H K) towards that ſide on which you will haue the angle to be. Thē opening your cōpaſſe to the ſhorteſt lēgth betweene the prickes F & G, pitche one foote of the ſame cōpaſſe vnaltered on the point H, & with the other foote therof make a pricke (marked here with K) on the ſaid archeline, & draw a right line frō the ſaid point A to the ſaid point K. This done you haue made at the point A an angle equall to the angle at the point D which is the thing that was required to be done.

CHAP. LI.

How by two diuers wayes you may draw ouer a point geuen a parallel or equidiſtant line to a right line geuen.

ADmitting A to be the point geuen and B C to bee the line geuen, drawe a right and ſlope line from the ſayd point A to what part you will of the ſayd line B C and marke that ſlope line with A D. Then by the arte taught in the 49. Chapter of this third booke, make at the point A on the line A D the angle D A E, which muſt be equall to the angle A D C, and produce the line E A to the point F. So the line E F

produced ouer the ſaid point A is a parallel and equidiſtant line to B C the right line geuen, which is the thing that was promiſed to be done.

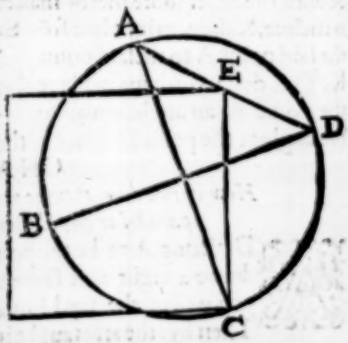


Alſo you may by a point geuen drawe a parallel or equidiſtant line to a right line geuen after this maner. Admitting B F A to be the line geuen, and C to be the pricke geuen, open your compaſſe to the iuſt meaſure betweene B F A the line geuen, and C the pricke geuen: then pitche one foote of your compaſſe vnaltered at one ende of the line geuen, and with the other foote thereof drawe an archeline right ouer the pitch of your compaſſe. Likewiſe doe at the other ende of the line, and afterwardes drawe a right line that ſhall touch the vttermoſt edge of both thoſe archelines: which done, the right line ſo drawne, and marked in the figure following with E C D, is a true parallel and equidiſtant line to B F A the line geuen.

CHAP. LII.

To cube any aſſigned Sphere.

DEſcribe a circle, let the diameter of the ſame circle be equall to the diameter of the aſsigned Sphere which you wil cube, & diuide that circle into foure equall partes with A C, and B D two croſſe diameters. After this drawe a right line from A to D, diuide the ſaid line A D into two equall parts in the point E, & draw a right line frō the ſaid point E to the point C. This done, the ſaid line E C is the iuſt length of one ſide of the deſired cube, which in his ſolide cōtent is equall to the ſolide content of the ſaid aſſigned Sphere.



The end of the third Booke of LVCARSOLACE.

Requies inſequitur laboret.

THE FOVRTH BOOKE OF LVCARSOLACE, CONTAINING CERTAINE NOTES BY WHICH ANY READER MAY KNOW

fruitfull, barren, and minerall groundes, grouthes, ages, and ſolide contents of trees, where a good aire is, how to build for the preſeruation of health, how a tunnel of a chimney may be made ſo as no ſmoke ſhal annoy him in his houſe, how to fell timber and make ſound and good boordes for buildinges, at what time he ought to ſinke a well, where a ſpring of water is, whether or no a new found ſpring of water will drie vp in an hot and drie ſommer, how water in a ſhallow well is more holeſome than water in a deepe well, how euery well ought to be vncouered and often tymes drawne drie, how the vſe of water is neceſſarie, how diuers ſortes of water haue diuers qualities, how there are diuers meanes to try among many ſortes of water which water is beſt, how much ſtore of water may be throwne out of a new deuiſed ſquerte vpon any fiered houſe or other thing, how the right leuel of any peece of ground may be foūd, how any water leuel may be found, how water may be brought in pypes of baked earth, in pypes of lead, and in pypes of alder, firre, or pyne tree wood, or in gutters within the ground, vnto any appointed ſeſterne, how to finde any depth of a ſea, how to breake the force of running waters which weare away land, how to draine wet groundes and bogges, and how to doe many other commendable and profitable thinges; in part collected and tranſlated out of diuers Authors in diuers languages, and in parte deuiſed by CYPRIAN LVCAR Gentleman.

CHAP. I.

How you may know rich, fat, and fruitfull groundes, and how you may know cold, leane, and barren ſoiles.

AGood ground doth naturally bring forth of his owne accord without any dreſſing or dūging high, ſtraight, and well ſpread elmes, okes, aſhes, ſloe or bullace trees, wilding or crab trees, brambles or blackberie trees, blackthorne, walwoortes, danewoortes, three leaued graſſe or treefoiles, ruſhes, mallowes, corne thiſtelles, white or redde hunny ſuckels or hunnie ſuckell leaues, graſſe thicke at the ground, or other good plantes,

fruits and herbes.

Alſo this is to be noted, that a ground which beareth naturally good wilde fruites and weeds, will if it be well dreſſed, bring forth good fruites, and good herbes.

Alſo where the Crowes, and Pies follow in great number the plow, ſcraping in the ſteppes of the plowman, there the ground is rich, fat, and fruitfull.

The beſt ground for tillage is a mellow ground that is fat, and will ſoone be deſolued, the next in goodneſſe is that which is fat and ſtuffe, and (as ſome ſay) the ground where ferne doth grow is good for corne.

Alſo where the earth is in colour like vnto new wax, there is good ground.

Alſo a blackiſh or yellowiſh earth which with il dreſſing doth not diſſolue, nor is myrie with much raine that hath falne vpon it, but drinking all in, retaineth there the ſaid raine water for a long time, is a rich, fat and fruitfull ground.

Alſo where the ſuperficies and face of the earth is not hard in winter, there is good ground.

Alſo where the earth wet with raine or other water ſwelleth, and waxeth ſomewhat dirtie and blacke, and doth not harden and ſhew whitiſh, there is good ground.

Alſo where houſes or other buildings haue bene ſcituated, there is good ground.

Alſo where the earth doth yeeld a pleaſant ſauor at the ſunne ſetting, or in a ſhewer of raine following a great drouth, there is good ground.

Alſo if the earth that hath line for the ſpace of three houres in ſauorie water hath a good taſt, it is a ſigne that the ſaid peece of earth was taken out of good ground.

Alſo if a turfe or ſod of ground ſprinkled with water ſhal thereby be clammy, & being handled cleaue vnto your fingers like pitch or wax, and throwne downe vpon the ground ſhall not break, it is a ſigne that the ſame turfe or ſod was taken out of good ground.

Alſo if a bigge clod of earth taken out of any peece of ground, and laid in an earthen pan full of ſweete and ſauorie water for the ſpace of two or three houres, ſhall not change the taſt of that water, or if a clod of earth beaten or preſſed well in a veſſell full of ſweete and ſauorie water, ſhall not mar the good taſte of the ſame water (which after it hath bene ſtrained thorow a linnē cloth, and ſuffered to ſettle or cleare, may without feare of harme be taſted in your mouth) it is a ſigne that the ſame clod was taken out of a rich & fruitful peece of ground: for water ſauoreth naturally of the earth on which it lieth or runneth: but if a clod ſoked in ſweete & ſauorie water ſhall cauſe the ſame water to haue a bitter taſte, it is a ſigne that the ſame clod was taken out of a barren peece of ground: and if a clod ſoked in ſweete and ſauorie water ſhall cauſe

the

the ſame water to haue a ſaltiſh taſte, it is a ſigne that the ſame clod was taken out of a peece of ground which is vnfruitfull, vile, and of no account.

Alſo to know fruitfull and barren grounds, digge a pit, and after two or three dayes throw into it by a little at a time all the earth that was caſt out, and in ſo doing, treade downe the ſame earth with your feete: then if the earth ſo throwne in and troden downe ſhall ſwell, and lie in a heape aboue the brims of the pitte, it is a ſigne that the ground there is rich, fat, and good for corne: but if the earth ſo throwne in and troden downe ſhall reach vp to the brims of the pit and no higher, it is a ſigne that the ground there is meanely good, and may ſerue for vines and paſtures: And if all the earth ſo throwne in and troden downe ſhall not be enough to fill vp the ſaid pit, or if the earth ſo throwne in ſhall gape much or chappe, it is a ſigne that the ground there is a leane and hungrie ſoile.

Alſo that ground is vnfruitfull which is white, bare, or leane with ſand, or wholly chalke, or all ſand lacking a mixture of perfect earth.

Alſo a ground which aboundeth with clay, or is ſo drie that it will open and gape in ſummer, is vnfruitfull.

Alſo the ground which aboundeth with filthy ſand or grauell, or with drie barren, great grauel, or with ſtonie, barren, and glittering duſt, is vnfruitfull.

Alſo the ground which aboundeth with ſtones, raddell, or preble, is ouerheated with the ſun, and burneth the rootes of euerie thing that is put into it.

Alſo the ground which is rough, verie ſtiffe or tough, or fennie, or mariſh, or ſlimie, or redde, or drie and thicke, or dry, leane and ſtiffe, or leane and cold, is vnfruitfull.

Alſo the ground which doth naturally bring forth ſhort trees or ſhrubbes, pricking plants, or bitter herbes, as buſhes, iuniper, thornes, briers, fyrſes, broome, ferne, brake, hethe, or wormewood, is vnfruitfull.

Alſo where lothſome and ill weeds do grow, there the ground is leane and bitter, where ferne and withered plants do grow, there the ground is cold, and where ſad and ill coloured plants, weeds, or herbes do grow, there is a wet and moiſt ground.

Finally, if you will digge with a ſpade diuers holes or pits in diuers places of an vnknowne field, you ſhall by ſo doing perceiue how thicke the mould of good earth is in that peece of ground, and whether any chalke, grauell, ſand, raddell, ſtones, or any hurtfull thing is vnder the ſaid mould of good earth: which will be worth your labour to know, conſidering that by looking onely vpon the ſuperficies or face of a field, you may ſometimes take a leane, hungrie and barren ſoile, for a fat, rich, and fruitfull ground.

CHAP. II.

To know whether metall or cole, be within any peece of ground.

DIgge a hole eight or nine foot deepe in the earth, and whelme a new elme bole in the bottome of the ſaid hole. After this, fill vp the hole againe

with the earth you tooke out verie cloſe for ſixe weekes ſpace, and at the end of ſixe weekes digge out the bole, and then the bottome of the bole wil in colour be like vnto the mettall, or cole, that is vnder, or neere about the ſame hole, as I haue read in a written booke of an vnknowne Author.

CHAP. III.

To knowe the grouth and ſolide content of any tree.

CVT the tree ſlopewiſe to the pith, tell the iuſt number of ſeames which are betweene the barke and the pith, and then note that the tree is of ſo many yeares grouth, as you may ſee ſeames there. But to know the ſolide content of a tree, you muſt with a paire of calleper compaſſes meaſure the thickneſſe or diameter of the tree at the toppe, and alſo at the foote: or for lacke of a paire of calleper compaſſes, put a girdle or ſtring that will not ſtretch round about the tree at the toppe and alſo at the foote, and forſomuch as the thickneſſe or (which is all one thing) the diameter at the foote of the tree will differ from the thickneſſe and diameter at the toppe of the tree, meaſure exactly ſo much of the girdle or ſtring as went about the tree both at the toppe and alſo at the foote, that you may know therby the circumference of the tree in either of thoſe two places, and afterwards by the art taught in the 22. chapter of the ſecond booke of this treatiſe, finde out the true thicknes & diameter of the tree in either of the two places which were ſo girded about. All this being done adde togither both the diameters ſo found, and take halfe thereof for another diameter, whoſe plaine or baſe multiplied in the length of the tree betweene the two firſt meaſured diameters, will produce the ſolide content of the tree in that length. As for example the thickneſſe or diameter at the toppe of the tree is foure foote, the diameter of the tree at the lower end is ſixe foote: ſixe and 4. added togither make 10. the half of 10. is 5. which muſt be another diameter whoſe circumferēce will be $31\frac{1}{7}$ of feet. Now multiplie $\frac{11}{7}$ the halfe of the circumference by $\frac{1}{4}$ the halfe of the new diameter, & the product thereof being $\frac{77}{14}$ of feete ſheweth the area of the baſe of the ſaid circumference, & whē you haue ſo done, multiply the ſaid area of the baſe of the circumferēce by 27. foote the length or heigth of the tree betweene the 2. places which were girded about with a ſtring, or meaſured with a paire of calleper compaſſes, and ſo the product will expreſſe the ſolide content of the tree to be betweene the ſame two places 530. foote & $\frac{1}{14}$ of a foote.

CHAP. IIII.

How you may know where a good and pure aire is, and how a good and pure aire may be corrupted.

INſomuch as aire doth both encloſe vs about, and alſo enter into our bodies, eſpecially the moſt noble member which is the hart, and that we can not be ſeparated one houre from it for the neceſſitie of breathing, we ought to haue therof a ſpeciall regard, and make our habitation in an wholſome aire which is alwayes faire

faire and cleere without vapors and miſts, lightſome, and open, not darke, troublous, or cloſe, nor ſtinking, infected, or corrupted. And herein this is to be noted, that as euery aire which is ſoone cold after the ſunne is ſet, and ſoone hot after the ſunne is riſen, is both ſubtile and wholeſome, ſo the aire which is contrary to this, is and worketh the contrarie, and the aire moſt to be refrained is that which wringeth and bindeth hard the hart, and doeth make ſtraight the attraction of aire. And withall this muſt not be forgotten, that churchyards, ſtinking diches, ſtanding waters, gutters, canels, ſinks, dunghils, water in which hempe or flaxe hath bene watered, ſnuffes of candels, ſauor of apples, influence of ſundrie ſtarres, miſtie & cloudie weather, vehement winds, piſſing in draughts, carrion lying long aboue the groũd, a multitude of ſluttiſh people in a ſmall roome, and vnſauorie ſmels of the butterie, celler, larder houſe and kitchin do and will alwayes putrifie and corrupt aire.

CHAP. V.

How a dwelling houſe in the countrey may for the preſeruation of health be ſituated and builded, and how the tunnell of a chimney may be made ſo as no ſmoke ſhall annoy you within your houſe.

SCituate your dwelling houſe in the countrey vpon an hill or an hills ſide, in a good aire, becauſe an high ground is more drier and wholſomer than a low place, and nothing maketh men of better cheare and quicker ſpirit than a freſh, pure, pleaſant, and lightſome aire. And for your intended houſe chooſe a dry place opẽ to the ſun where you may alwayes haue wood inough, and no want at any time of wholſome water, and if you may, let that place be by a brookes ſide that may receiue and carie away al the filth which ſhal come out of your houſe, yet farre from the ſea and ſwift running riuers which will ouerflow or weare away your grounds by which they paſſe if the walles and bankes which keepe out the water ſhall happen to decay, farre from marriſh, fennie, plaſhie, and foggie grounds which are enemies to health, far from forts and townes where ſouldiers lie in garriſon, for wicked ſouldiers will range abrode and offer to ſpoile you, and farre from ſcornefull or brabling neighbors who with ill ſpeeches will contemne you, and with intollerable wrongs will dayly vexe you. And before you begin to build, make a model, or cauſe a plat to be drawne of your houſe that ſhall be framed, and conſider well of the coſt which you muſt beſtow vpon it, for beſides workmanſhip many nailes, many pinnes, many lathes, many tiles or ſlats, many boords, many ſtones or brickes, many lockes & keyes, much timber, much lime, much ſand, much glaſſe, much yrõ & much lead do belong to building. Alſo remẽber to lay the foundation of your houſe vpon a grauel ground mixt with clay well rammed downe, or vpon a rocke of ſtone the moone being in a fixed ſigne as in Taurus, the laſt halfe of Scorpio, leo, or aquarius. Build the outmoſt walles of your houſe with

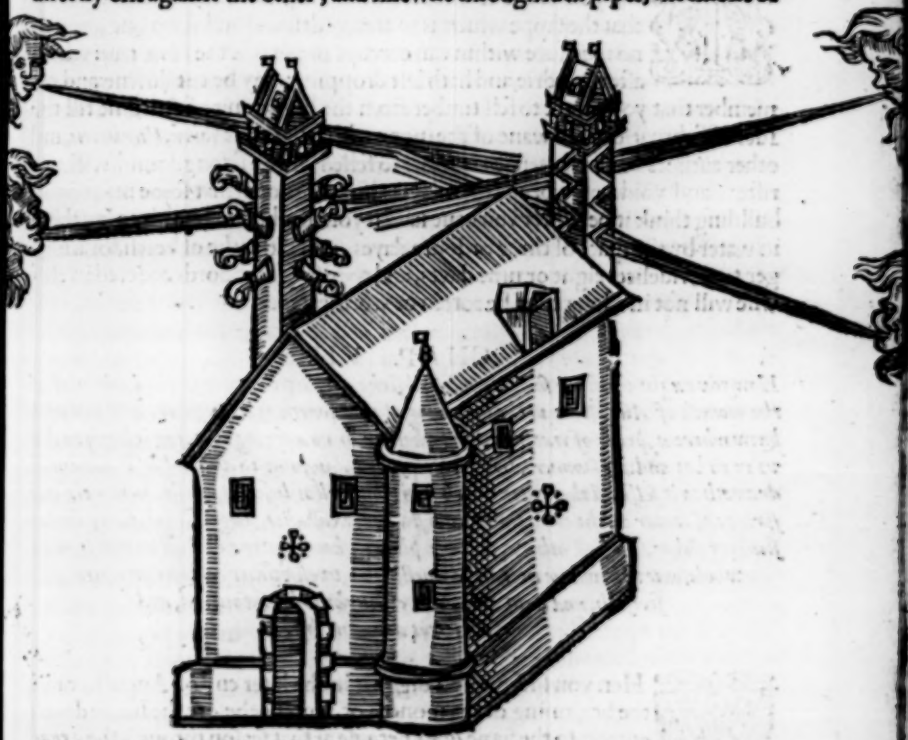
strong and durable timber, or with stones, or with brickes which ought to be made and well burned eight yeares before you do build with them, according to a law and vse at this time obserued in many places within Italie. Here for that I haue heard some men say, that a building with brickes will be of a small continuance, I must a litle digresse to tell you of this wonder: In the booke of the principall nauigations, voyages and discoueries of the english nation. pag. 232. published by M. Richard Hakluit, it is written that one Iohn Eldred an English man did view at diuerse times with good aduisement in anno Domini 1583. a remnant of the tower of Babel (wherof mention is made in the 11. chapter of Genesis) which yet is aboue a quarter of a mile in compasse, and almost as high as the stoneworke of Paules steeple in London, though a farre off it sheweth much bigger, and that the brickes remaining in the same most ancient monument be halfe a yard thicke and three quarters of a yard long, and that betweene euerie course of brickes there lieth a course of mattes made of canes which remaine sound and not perished as though they had bene layd within one yeare: by which it is manifest that they do greatly erre which say that a building made with good and well burned brickes can not long endure or continue. But now to returne from whence I did digresse, I do also aduise you when you shall make a vault in your building, to frame the heigth therof equall to ½ of the bredth thereof, and for healthes sake, let the principall dores and windowes of your house open to the Northeast, Southeast, or Southwest: for in the North side the aire is cold and drie which prolongeth life, the South wind is hot and moist which corrupteth, the West wind is cold & moist which is wholsome, and the East wind is hot and drie which is ill for man and beast. Moreouer make all the roomes within your house lightsome, of a conuenient heigth, and of a laudable largenesse: build in euery chamber within your house a chimney, lodge alwayes in an high chamber that is seuered from the roofe with a floore betweene, rather than in a roome below, and place your bedsteds in your chambers where the moone may not shine vpon their faces which shal sleepe or lie in them, because the mooneshine vppon their faces and eyes will hurt their sights, and beware you do not sleepe at any time in a close place, nor vpon the ground, nor vpon cold stones, for both the coldnesse of stones, & the damp of the earth are hurtful to our bodies. And cõcerning the place in which we will sleepe, it must be somewhat darke, defended from the sunne beames & from light, it must be temperate in heate and cold, and rather inclining to cold than heate. For if we sleepe in a place very hot, we are in danger to fall into a sowne by reason of the contrarietie of sleepe and heate. For naturall heat which by meanes of sleepe is drawne inwards, through the heate without is contrariwise drawne outwards. Also adioine vnto your house a delightsome garden and a large orchard, laying them open in a cold countrey to the South, and in a hot countrey to the North: decke your garden with faire, long, brode, and drie alleys, and goodly knots of pleasant floures, and sweet herbes: plant chec-

Note.

Tower of Babel.

ker

ker wiſe or netwiſe in your orchard many trees of the beſt and moſt wholeſomeſt frutes, and in no wiſe ſuffer a ſtable, oxeſtall, ſtanding poole, filthie ditch, or ſtinking ſinke to be neare vnto your houſe, garden, orchard, or walking places for pleaſure. And to the ende you may not within your houſe be annoyed at any time with the ſmoke of fire (which except it may eaſily paſſe vpwards into the aire through the tunnels of your chimneyes, draweth as *Gregorius Nazianzen* ſaith, into corners, infecteth houſes, and maketh them black) I counſell you to make in each ſide of euerie tunnell diuers triangular holes, or two pipes of iron, ſtone, or baked earth: of which pipes one muſt lie aſlope with his mouth vpwards, and the other muſt lie aſlope with his mouth downwards: for through ſuch triangular holes made in the ſides of the tunnell not directly one againſt the other, and likewiſe through ſuch pipes, the ſmoke of



fire will eaſily paſſe out of any tunnell howſoeuer the wind bloweth, except at one inſtant time eight ſeuerall winds ſhall blowe out of the aire from eight

ſeuerall points or places, and that at one and the ſame inſtant foure of thoſe winds ſhall blow vpwards and other foure blow downwards, which is a thing impoſſible to happen.

CHAP. VI.

How timber ought to be felled, how the beſt time for felling of timber is betweene the beginning of Autume, and the Ides of Februarie in the wane of the moone, and how boords which haue lien in water will not in a long time be rotten or wormeaten.

THE maner to cut downe timber is thus: firſt cut the timber tree till you come to the middle of the pith, then ſuffer it to ſtand that the ſappe which is in it may deſcend and drop out, and ſo no moiſture within can corrupt or putrifie the ſame tree: which after it is drie, and hath left dropping, may be cut downe: and remember that you ought to fell timber from the beginning of Autume till the Ides of Februarie in the wane of the moone, becauſe (as *Schoner*, *Vitruuius*, and other authors haue written) the timber ſo felled will be ſtrong, ſound, without riftes, and voide of wormes. And it is alſo to be noted that ſome maiſters in building think it beſt, after you haue ſawen your timber for boords, to lay them in water by the ſpace of three or foure dayes, and if they be of beech, for a longer time, videlicet eight or nine dayes, and they ſay that boords ordered in this wiſe will not in a long time be rotten or wormeaten.

CHAP. VII.

How you ought chiefly to ſinke a well, and ſeeke a ſpring of water in the later ende of the moneth of Auguſt, or in the beginning of the moneth of September, how you may know where a ſpring of water is, and whether or no a ſpring of water is likely to dry vp in an hot and dry ſommer, howe a deepe well adioyning to a well of leſſe deepeneſſe draweth to it ſelfe all the water which is in that well of leſſe deepeneſſe: how wels and ſprings of water ought to be farre from ſtables, oxeſtalles, hoggeſtiues, filthy diches ſtinking ſinkes, and all other vncleane places, how water in a ſhallow well is more wholeſome then water in a deepe vvell, hovv vvell vvater ſeldome or neuer freeſeth, and hovve euery vvell ought to be vncouered, and often times drawne dry.

WHen you ſinke a well digge it in the later end of Auguſt, or in the beginning of the moneth of Septẽber before the ſunne doeth enter into the ſigne *Libra*, becauſe at that ſeaſon through the great heate and drineſſe of the ſummer, the earth wanteth raine and moiſture. And to the end you may know before you beginne to ſinke a well (be it that you will do ſo in the top of an hill, or in the ſide of an

hill

hill, or in a valley) whether or no a ſpring of water may be found in the deſired place, lie downe flat vpon the ground in a morning before the ſunne riſeth, and turning your face towards the Eaſt, looke where any vapor riſeth vp like a litle cloud out of the ground: for if you will ſinke a well in the place from whence ſuch vapours do then ariſe, you ſhal (as *Charles Eſtienne* and *Iean Liebault* haue written) find a ſpring of water. Alſo (as the ſame authors do teſtifie) you ſhall find a ſpring of water within that peece of ground out of which vapours like litle clouds do come in a drie and faire ſeaſon. Likewiſe if you will make trenches of foure foot deepe, and lay in them locks or fleeces of drie and cleane wooll couered all ouer with boughs of trees, or leaues of herbes, you ſhall within a ſhort time perceiue whether any ſpring of water is within the ground neare vnto the ſame trenches: for if the ſame lockes or fleeces of wooll after they haue in ſuch maner lien a while in the trenches ſhall be drie, they ſhew by their drineſſe that there is no ſpring of water within the ground neare vnto the ſaid trenches: but if the ſame fleeces of wooll after they haue in ſuch maner line a while in the trenches ſhal be ſomewhat moiſt and wet, they ſhew by the litle ſtore of moiſture or water within them, that there is a ſmall ſpring of water within the ground vnder or neare vnto the ſaid trenches: and where the ſame fleeces of wooll after they haue in ſuch maner line a while in the trenches ſhall be very much moiſt and wet, they ſhew by the abundance of water and moiſture within them that if you ſinke a well where the ſaid trenches are, you ſhall find a great ſpring of water within the ground vnder or neare vnto the ſame trenches. Moreouer if you will ſinke a deepe well where plantaine, dogges tooth, trefoile, cinkefoile, millefoile, yarrow or noſebleed, veruaine, cammomill, foxtaile, wild peniroyall, ſage brought from beyond ſea otherwiſe called adiantum, Venus haire, maidenhaire, colonder, or wild ferne doth plentifully grow, or where any other greene herbe or plant by nature without ſetting or planting doth flouriſh, and ſpread very thick, you ſhall find a ſpring of water. And herein this is to be noted, that a ſpring of water found in this maner, or by any other meanes in a red grauelly ground, or in a gray rocke, or in a blackiſh, ſandie, clayie, or red ſtonie ground (eſpecially if ſtones and grauell are mixed together) will ſeldome or neuer drie vp, as the ſprings of water found in a chalkie, mirie, dirtie, or ſlimie ground, or in a veine of earth vnder willowes, brambles, reeds, or other water plants will do. Note. Note.

This ought alſo to be remembred, that inſomuch as a deepe pitte or well made neare vnto a pit or well of leſſe deepeneſſe, draweth to it ſelfe all the water and filth which is in the pit or well of leſſe deepeneſſe, it is requiſite that your deepe welles and ſprings of water ſhould alwayes be farre from your ſtables, oxeſtalles, hoggeſtiues, ſinkes, filthie diches, and euery other vncleane place: ſo as they may not be poiſoned with any filth that ſhall come from thence. And beſides all this it may auaile you to learne that the water in ſhallow welles is better and more wholeſomer then water in deepe welles, and that

by how much the water in a well is more neere to the face or ſuperficies of the earth, by ſo much it is more open to the aire and ſunne, more colder, more freſher, and more purified: And although water in a deepe wel is warme in winter, and cold in ſummer, and ſeldome or neuer freeſeth, yet it taketh quickly corruption, eſpecially if the well be couered, or not oftentimes drawne drie. For nothing better preſerueth water in a deepe well from putrifaction, than inceſſant or often agitation, & water once corrupted impoiſoneth the ſprings of new waters letted or lacking their free courſe and paſſage: but ſtill drawne new commeth on more freſh and ſauorie: whereby it is euident that the more you draw out of a deepe well, the more better, and more wholſomer is the water therein, and that by continuall motion, corruption leſſe ingendreth.

CHAP. VIII.

Hovv the vſe of vvater is neceſſarie, hovv diuers ſorts of vvater haue diuers qualities, hovv by diuers meanes you may trie among many ſorts of vvater, vvhich vvater is beſt, hovv ſea vvater may be made freſh and potable vvater, and hovv great ſtore of vvater may be throvvne out of a nevv deuiſed ſquert vpon any fiered houſe, or other thing.

WAter breedeth corne and fruit, bringeth forth trees, herbes, and graſſe, waſheth away foulneſſe, ſeetheth our meat, giueth drinke to man and beaſt, quencheth fire, and is the cauſe of all liuing & growing things, and (as *Ariſtotle*, *Plinie*, and *Bartholomeus* haue written) diuers waters haue diuers qualities, and euerie ſpring or well of water hath ſauor and kind of his owne ground, ſo as if the ground be ſweete and pure, the water will alſo be ſweete and pure, and contrariwiſe if the ground be brimſtonie and ſlimie, the water will ſauor of brimſtone & ſlime, & if the well in his owne ſpring be corrupt & vicious, all that runneth out is vicious and corrupt. And here this is to be remembred that the ſpring and riuer water which runneth Northwards is wholſomer water then that which runneth towards the South, and that the ſpring and riuer water which runneth out of an high hill or mountaine from the North towards the Eaſt, is more wholſomer than any of the ſaid two ſorts of running waters, and that a ſpring of water which runneth Weſtwards is leſſe worthie than any of the ſaid three ſorts of running water and that by how much more farther a ſpring of water runneth, by ſo much it is more better. Alſo this is to be noted that the water which ſpringeth out of an high hill or mountaine, and runneth ſtrongely and ſwiftly thorow rockes, or ſtones, or vpon cleere ſtones, or grauell, or thorow a mine of gold, is wholſome water. Likewiſe it may profite vs to know that the raine water which falleth in ſummer when it doth thunder and lighten, is wholſome water, and that the raine water which is gathered in a milde or dribling raine, and before it toucheth any houſe, or other foule or duſtie

duſtie thing, is receiued into ſome cleene and pure veſſell will be more ſauorie, more cleene, more light, and more wholſome, than any other water: and (as I haue heard ſome of good credit ſay) raine water thus taken in the moneth of May, and ſtrained thorow a cleene linnen cloth into a faire & ſweete glaſſe, will continue good and ſweete in the ſame veſſell for the ſpace of two yeares togither, and will heale redde eies waſhed therewith.

If you paſſing through ſtrange and vnknowne places ſhall be deſirous to learne whether or no the water there be wholſome, you may to fulfill your deſire, diligently and with aduiſement view all the places about the ſame waters, and enquiring how long the people which vſually drinke of the ſame waters do liue, marke their bodily conſtitution, diſpoſition, and nature, whether they be of good complexion, healthie, ſtrong, and valiant, and whether they haue good and cleare voices, eies not infected, legges of good proportion and able, for as ſuch a people whereſoeuer they abide do witneſſe that the water of which they vſually drink is wholſome, ſo the people which are of a contrarie making, diſpoſition and nature, do ſhew that the waters of which they vſually drinke are vnholſome. But when a well is newly made, or a ſpring is late found, ſo as the aforeſaid experience of no part can helpe you, then if the water of the ſame well or ſpring haue no ſauor, ſmell, nor colour, and being cleere like vnto the aire will ſodainly take the colour of any thing caſt into it, or if it be light, cleene, luke warme in winter, and ſomewhat cold in ſummer, or if it will ouer a fire be ſoone hot, and taken from the fire be ſoone cold, or if peaſe, beanes, and other like pulſe will in it quickly boile, it is good & wholſome water. Alſo if you let fall one drop or two of water vpon a ſteele glaſſe, or vpon a ſiluer, copper, or braſen baſon, or other veſſell wel pulliſhed, and ſuffer the ſame drops to drie thereon, and after they are drie can finde no ſtaine or marke in the ſaid glaſſe or veſſel, the water ſo prooued is good and wholſome. Likewiſe if you boile water in a veſſell, and after it hath well boiled ſuffer it for a time to ſtande, ſettle, and coole, and when you ſhall emptie it can finde no kind of ſlime or ſand in the bottome, it is a ſigne that the ſame water is good and wholſome. Note.

Among many ſorts of water, you may trie by diuers meanes, which water is beſt and moſt wholſomeſt: for the water which is lighteſt in poiſe or waight is better and more wholſomer than the water which is not ſo light: and the water whereof commeth leaſt ſkimme or froth when it doth boile, is better & more wholſomer than the water which in boyling giueth more ſkimme or froth. Alſo the water which being ſet ouer a fire will be ſoone hot, and taken from the fire will be ſoone cold, is better and more wholſomer than the water which being ſet ouer a like fire in a like veſſell, will not be ſo ſoone hot, or that being taken from the fire wil not be ſo ſoone cold. Moreouer if linnen clothes depped in ſundrie waters be laid forth to drie, the cloth which is ſooneſt drie ſheweth that the water in which it was depped is more ſubtile, & more whol-

ſomer, than the water in which the other clothes not dried ſo ſoone were depped. And inſomuch as I haue told you that the lighteſt water is beſt & more wholſomer than the water which is not ſo light, I wil alſo ſhew how you may know among many ſorts of water which is moſt lighteſt: for which purpoſe cut a linnen cloth into two or more equal parts or peeces of like waight, putting one peece into one water and the other peece into an other water vntill they all be throughly wet, then wring out all the water in them, or hang them in the aire where the ſunne may not ſhine on them vntil they be drie, and then rewaigh them againe: for the cloth which ſhall then waigh moſt lighteſt, ſhewth that the water in which it was depped is better and more wholſomer than the water in which the other peece of cloth of more waight was depped. Or if this way ſhall not like you, waigh your water in pure and cleane veſſels of like waight and bigneſſe without any other curioſitie, and by ſo doing you ſhall ſee which water is moſt lighteſt.

I haue ſeene men and women of great age, and ſtrong bodies, which neuer or verie ſeldome dranke other drinke than pure water, I thinke therefore if Engliſh men from their infancie were accuſtomed to none other drinke but water onely moderately vſed, it would be ſufficient to keepe natural moiſture, and to cauſe the meate that is eaten to pearce and deſcend vnto the places of digeſtion, which are the purpoſes that drinke ſerueth for. But howſoeuer men ſhall iudge of this my opinion, it is certaine that after a great ſurfet ſpecially taken with ſuperfluous eating of banqueting meates, cold water drunken is a generall remedie. Beſides this *Hippocrates* affirmeth that in ſharpe and feruent diſeaſes, none other remedie is to be required than water, and that in ſuch ſickneſſe where you feare leaſt the head ſhould be vehemently greeued, or the minde periſhed, you muſt there either giue water, or white wine alayed with much water. Alſo *Galen* willeth vs to ſuffer our children to drinke water of a cleene fountaine when they feele themſelues verie hot after meales, and deſire ſo to do: notwithſtanding you muſt beware of water of which ſalt is made by ſtrong ſeething, and of water in lakes and ſtanding pooles, and of ſnow, haile, Ice, and mariſh waters, becauſe they harden the belly, hurt the ſtomake, make the ſpleene to ſwel, defile the ſkinne, and breed feuers and ſtones. And reſpect ought to be had to the perſon that drinketh pure and ſauorie water, for to young men and to them which are hot of complexion ſuch water is ſometime profitable, but to them that are feeble, old, fleumatike, or melancholy, it is not conuenient.

Note.

How ſea water may be made freſh and potable water.

There are ſome which do conſtantly affirme that ſea water doth make powdred fleſh to be freſh, and freſh fleſh to be ſauory. And (as Ariſtotle and Pliny haue writen) if we ſhould make certaine veſſels of wax hollow within, ſo binding or cloſing them that no hole or vent may be founde in them, and letting them downe into the ſea faſtened in ſome net or other fit thing with long lines or cordes whence (after they haue bene the ſpace of one whole day

in

in the ſea) if we againe draw them, we ſhall finde in euery of them a certaine quantity of good freſh water: whereupon *Taiſner* ſayth that ſea water diſtilled through a veſſell plaiſtred or cruſted ouer with cleane wax is made therby freſh, becauſe the water which paſſeth thorow the ſtreit and narrow pores of the ſweete waxe leauing all his ſaltneſſe and groſſenes within the ſame veſſell, ſauoreth of the waxy nature which is ſweete and pleaſant. And the ſame *Taiſner* doth alſo report that ſea water powred many times into a pipe filled with grauell or little ſtones, and ſuffered to paſſe thorow it into an other veſſell, will thereby become freſh, and ſerue for drinke. Some others alſo ſay that ſea water mixt with wheate floure waxeth ſweete: ſo as within two houres afterward a man may drinke thereof. I may recite an infinite number of other examples which will proue the neceſſary vſe of water, and the diuerſe qualities of diuerſe waters, but to auoide tediouſneſſe I will of purpoſe paſſe them ouer in ſilence, and here at the end of this chapter ſet before your eyes a type of a ſquirt which hath bene deuiſed to caſt much water vpon a burning houſe, wiſhing a like ſquirt and plenty of water to be alwaies in a readineſſe where fire may do harme, for this kinde of ſquirt may be made to holde an hoggeſhed of water, or if you will a greater quantity thereof, and may ſo be placed on his frame, that with eaſe and a ſmal ſtrength, it ſhal be mounted, imbaſed, or turned to any one ſide right againſt any fired marke, and made to ſquirt out his water with great violence vpon the fire that is to be quenched.

A ſquirt, and the vſe thereof.

CHAP. IX.

How you may know the right leuell of any peece of ground, and tell whether or no water may be brought from a ſpringe head vnto any appointed Seſterne, how water pipes of baked earth are better than water pipes of lead, how water pipes of Alder wood, Firre wood, Pine tree wood, or ſuch like wood as hath Roſen in it, are better than water pipes of baked earth, how you may know in any appointed place the difference betweene the right leuell and the water or circular leuell, how you ought to lay water pipes in a crooked and vneuen way, how water pipes of baked earth or of wood may be faſtened togither, how water may be brought in gutters vnder the ground to an appointed Seſterne, and how water of a ſpring or well which lieth vnder the right leuell line of the brimmes of a Seſterne, may by two new deuiſed frames be forced to paſſe in pipes vnto the brimmes of that Seſterne, and higher when need ſhall require.

LAY your geometricall table faſt, flat, and leuell vpon his foote fixed 100. yards (or if you will in a ſhorter meaſured diſtance) right in the way through which the water ſhall paſſe from the ſpring head to the appointed ſeſterne, and hauing in a readineſſe two long, ſtraight, and blacke poles, marked from their lower ends vpwards with feete, halfe feete, quarters of feete, inches, halfe inches, quar-

ters of inches,and more leſſer partes,commaunde one of your aſſiſtantes (who for a difference ſhall here be called your firſt aſſiſtant)to pitch vpright one of the ſaid poles in the ſpring head, & require your other aſſiſtant(who likewiſe for a difference ſhall here bee called your ſecond aſſiſtant) to erect plumbe vpright the other pole 100. yardes (or if you will in a ſhorter meaſured diſtance) from the foote of your table in the ſaid water way. After this laying your ruler flat vpon the ſaid table(which as before I haue told you ought now to lie in an equal and leuel heigth,to the end the things which ſhal be eſpied vpon the ſaid poles through the looking ſightes or groofe in the ruler,may lie in a true leuel with your eye) geue a knowne ſigne to your firſt aſſiſtant at the ſpring head, to moue there a leafe of white paper vp or down vpon the ſide of the pole, vntill by turning your ruler to or fro, you may behold through the ſaid looking ſightes or groofe the vppermoſt part of the ſaid leafe of paper: and then making him to vnderſtand by a knowne ſigne that he muſt there ſtay the paper: and marke the iuſt meaſure of feete,inches,and partes of an inch touched with the vppermoſt part of that paper leafe, which is then leuel with your eye at an heigth aboue the ſuperficies of the ſaid water ſpring,go to the oppoſite end of your table,and turne your ruler againe vpon it,vntill you may ſee through the ſaid ſightes or groofe the vppermoſt part of an other like leafe of white paper which ought by your ſecond aſſiſtant to be lifted vp or down cloſe by the ſide of the other pole,as the leafe of white paper was lifted vp or down by the ſide of the pole in the ſpring head,and then as you did before,ſhew him a knowne ſigne to ſtay the paper there, and to note with good regarde the meaſure of feete, inches, and partes of an inche touched therewith,which(as before I haue declared)is a marke that lieth then leuel with your eye,and ſheweth the height of the ſame vppermoſt part of paper aboue the ground in the place where this other pole is erected. All this being done,require your firſt aſſiſtant to take vp the pole which was pitched in the ſpring head,and bringing it with him,to tel you truly at what height aboue the ſuperficies of the ſaid water ſpring,the vppermoſt part of his paper was when he by your ſigne geuen vnto him,did ſtay it vpon the pole: and then faile you not to write in your memoriall vnder this title *Reports of the firſt aſſiſtant*, the ſaid heigth as he reported it vnto you. In like maner note in your memoriall(as your ſecond aſſiſtant ſhall informe you, vnder this title *Reports of the ſecond aſſiſtant*, at what height aboue ground the vppermoſt part of the other leafe of paper was,when he did by your ſigne giuen vnto him, ſtay it vpon the pole ſet in the ſaid water way betweene your table and the place where the ſaid feſterne is appointed to ſtand. After this cauſe your ſecond aſſiſtant to go forwards right in the ſaid water way towards the feſterne 200. yards (or if you will in a ſhorter meaſured diſtance from the pole by which he ſtoode before,and at the end of that meaſured diſtance to ſet plumbe vpright the pole which was brought from the ſpring head: for by reaſon of that which before I haue willed you to do,your ſecond aſſiſtant muſt

at

at euery one of your ſtations ſtand by the pole which ſhall be erected betweene your table and the ſaid ſeſterne, and your firſt aſſiſtant muſt at euery one of your ſaid ſtations ſtand by the pole which is erected in the water ſpring, or betwene your table and the water ſpring, and beſides this at euery one of your ſtations, place your table flat and leuell vpon his foote in the middeſt of the diſtance betweene the ſaid two poles. When your table and poles are ſo placed, and your aſſiſtants are againe readie by the ſaid poles, lay downe your ruler vpon the table, and turne it about thereon vntill you ſhall ſee thorowe the ſaid looking ſights or groofe the vppermoſt part of the paper leafe which at the very ſame inſtant muſt by your firſt aſſiſtant be moued vp or downe vpon the pole betweene your table and the water ſpring, and then giuing him a knowne ſigne (as you did at your firſt ſtation) to ſtay there his paper leafe, and to note truely the heigth of the vppermoſt part of the ſaid paper aboue the ground, looke from the other ende of your table thorow the ſaid ſightes or groofe, at the paper which in the verie ſame inſtant muſt likewiſe be moued vp or downe vpon the other pole by your ſecond aſſiſtant, and ſo ſoone as you ſhall by ſo doing ſee the vppermoſt part of that paper, geue vnto your ſecond aſſiſtant a like ſigne to ſtay there his paper, and with good heede to note the heigth of the vppermoſt part thereof aboue the ground After this call both your aſſiſtants vnto you, & will your firſt aſſiſtant to bring with him his pole, I meane that pole by which he ſtood at this your ſecond ſtation, and when you haue written in your memoriall vnder the ſaid peculiar and proper title (as you did at your firſt ſtation) the noted heigths of their papers, let your ſecond aſſiſtant go more forwards in the ſaid water way towards the appointed ſeſterne 200 yards (or if you will in a ſhorter meaſured diſtance) from the pole by which he ſtood at your ſecond ſtation, and at the ende of that meaſured diſtance, let him erect plumbe vpright the other pole, which at your ſaid ſecond ſtation ſtoode betweene your table and the water ſpring, and mouing his paper vppon this laſt erected pole, let him note the heigth aboue ground of the vppermoſt part therof, when he ſhall perceiue that you do looke at it through the ſaid looking ſights or groofe, and while your ſecond aſſiſtant is herin employed, cauſe your firſt aſſiſtant after he hath laide your table faſt, flat, and leuell vpon his foote in the middeſt of the diſtance betweene the ſaid two poles, to returne to the pole which then ſtandeth betweene the table and the water ſpring, and there lifting vp or putting downe his leafe of paper vpon the ſide of the ſame pole, to note the heigth aboue ground of the vppermoſt part of the ſame paper when you ſhall behold it thorow the ſaid ſights or groofe: and require both thoſe aſſiſtants to come againe vnto you after they haue noted the ſaid heigthes, that you may, (as before you haue bene taught to do) write in your memoriall vnder the ſaid peculiar and proper titles, their reportes of the noted heigths. Then conſidering that neither you or any of your aſſiſtants ought to do more or leſſe at one ſtation than at another, it behoueth you all to

Nota.

proceede at euerie other ſtation in the ſame order that hath bene obſerued by you at each of your former ſtations, vntill you haue alſo recorded in your memoriall the noted heigth of the paper aboue the brimme of the appointed ſeſterne which is the laſt heigth that you ſhall neede in this action to write.

All this being done, adde together all the noted heigths which are vnder the title *Reports of the firſt aſſiſtant*, and in the ſame maner adde together all the noted

noted heigths which are vnder the title *Reports of the ſecond aſſiſtant*, and if the whole meaſure of heigths vnder the title laſt recited exceede the whole meaſure of heigths vnder the title firſt mentioned, abate the leſſer meaſure from the greater, and take the remainer for the meaſure which ſheweth howe much the brimmes of the ſaid appointed ſeſterne are vnder the ſtraight leuell of the ſuperficies of the water in the ſpring head. As for example, ſuppoſing the noted heigths at euerie one of your ſtations to be written vnder the ſaid peculiar and proper titles in this ſort following, it will appeare by addition that the whole meaſure of heigths vnder the title *Reports of the firſt aſſiſtant*, wil amoũt vnto 18. foote, ¼ of a foote, 1. inch, and ¼ of an inch, and that the whole meaſure of the heigths vnder the title *Reports of the ſecond aſſiſtant*, will amount vnto 21 foote, and 2. inches: whereupon if you ſubtract the ſaid meaſure of 18. foote ¼ of a foote, 1. inch, and ¼ of an inch, out of the other meaſure, that is to ſay, out of 21. foote, and 2. inches, there remaineth 2. foote ¼ of a foote, and ¼ of an inch, for the meaſure of the depth at which the brimmes of the ſaid ſeſterne doe lye vnder the ſtraight leuell of the ſuperficies of the water in the ſaid ſpring, as by this table following will appeare.

Reports of the firſt aſſiſtant.

Station	Feete	Parts of a foote	Inches	Parts of an inch
1	15	0	3	½
2	2	0	1	¼
3	1	½	0	0

Summe total 18. foote, ¼ of a foote, one inch, and ¼ of an inch.

Reports of the ſecond aſſiſtant.

Station	Feete	Parts of a foote	Inches	Parts of an inch
1	3	0	2	¼
2	14	0	0	¼
3	3	½	5	0

Summe totall 21. feet and 2. inches.

Remainer 2. foote ¼ of a foote, and ¼ of an inch.

Hereby it is certaine that the ſaid deſired water may eaſily be brought frõ the ſpring head vnder the vpper part of the groũd in narrow gutters, or in pipes of lead, or (which are better) in earthẽ pipes, or pipes of baked earth, or (which are beſt of all) in pipes of alder wood, firre wood, or pine tree wood, or in pipes of ſuch wood as hath roſen in it, vnto the appointed ſeſterne, becauſe the ſaid water hath here ſo great a current, & for that (as *Leo Baptiſta Albertus*, *Anton. Maria*, and other authors haue written) water will paſſe in pipes vnto any appointed place, where the ground on which the water pipes do lie is foure inches & ⅓ inch lower at euerie miles end, than the ground at the ſpring head. But if this opinion concerning the difference betweene a ſtraight leuell and a water leuell, at euerie miles end ſhall miſlike you, meaſure by the art before

Difference betweene the right leuell and the water leuell.

taught, the diſtance betweene the ſpring head, and the ſeſterne into which the water ſhall fall, ſquare the meaſure of this diſtance, adde the product thereof to the ſquare of 3436. and $\frac{1}{11}$ the number of Italian miles in the earthes ſemidiameter; out of the product thereof extract the ſquare roote, and then, the ſaid number of 3436. and $\frac{1}{11}$ being ſubtracted from the ſaid ſquare roote, take the remainer for the difference betweene the ſtraight or right leuel, and the deſired water or circular leuell.

In the circumference of the whole earth there are 21600 Italian miles, and in the diameter of the whole earth there are 6872 Italian miles and $\frac{8}{11}$ of an Italian mile, which doth but a little differ from our Engliſh mile.

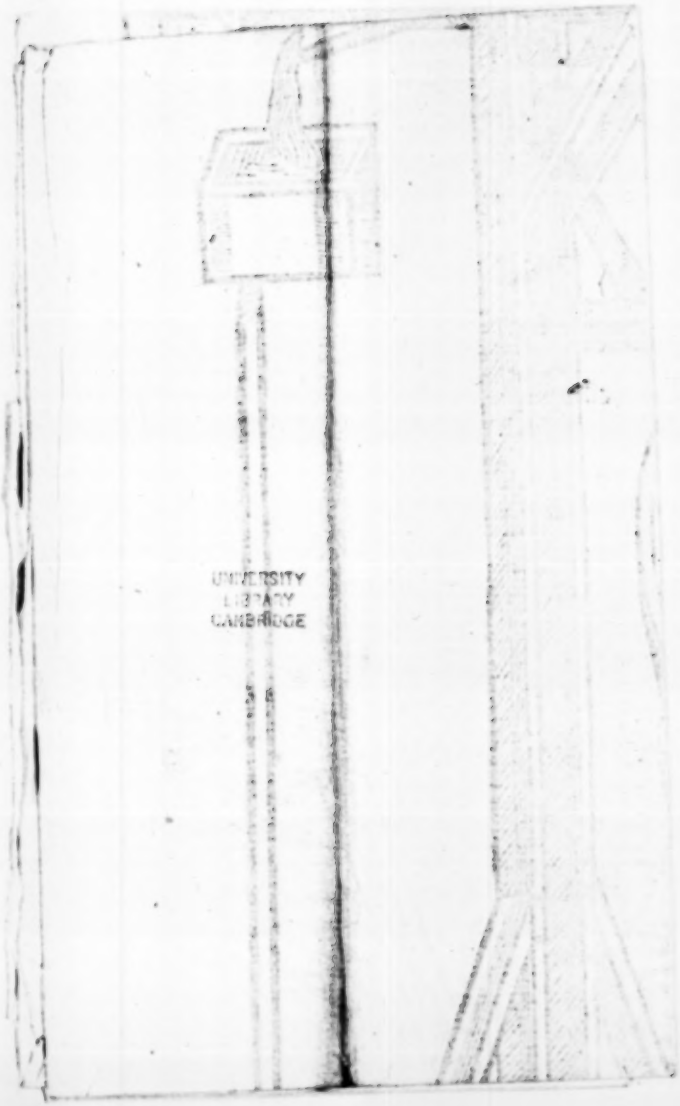
When a hill lieth in the water way, cut a narrow trench or ditch along by the ſide thereof, and lay the water pipes therein, and when a low valley, and a riuer, or any one of them ſhall lie in the water way betweene the ſpring head and the appointed ſeſterne, make ouer the ſaid valley & riuer an arch, or pitch vpright in diuers places along in the ſaid valley ground, and in the bottome of the riuer, diuers poſtes or piles of a conuenient length to carrie the water in pipes ouer the ſaid valley or riuer, as in the North ſide of London, and in the ſuburbes of Wincheſter betweene Saint *Marie* Colledge and S. *Giles* hill, and in a village called *Arcueil*, neere vnto *Paris* in France the like is done.

Moreouer this is to be noted that (as the ſaid *Anton. Maria* hath written) you muſt bring your water to the appointed place by a crooked way rather than by a ſtraight way, and lay the water pipes in ſome places of the crooked way a little vpwards, and in ſome places of the ſaid crooked way a little downwards, and that the ſaid water pipes of baked earth and of wood ought to be two inches, or at the leaſt two fingers thicke & ſmal or ſharpe at both ends, ſo as one of them may lye halfe a foote within another, and be faſt ioyned togither with ſimen or lute of wiſedome made of vnquenched lime and hogs greaſe, or of roſen and whites of egges, or of lime, whites of egges, & filings of iron, or after ſuch manner as is taught in the 106. chapter of my booke named *Lucar Appendix*.

It happeneth in ſome places that the ground all along the way in which the water ſhall paſſe from a ſpring head to an appointed ſeſterne is lower than the ſuperficies of the water in the ſame ſpring, and then to ſaue charges, you may bring the water vnto the appointed ſeſterne thorow a narrow dich or gutter drawne from the ſpring head vnto the brimmes of the ſeſterne: which dich or gutter ought to be filled one foote thicke with ſtones or grauell, and couered all ouer the ſtones (except in a few places) with the earth you digged out, to the end the water running thorow the ſame ſtones or grauell, may thereby be well purged and purified. But when water in a ſpring head or in a well ſhall be forced to paſſe vnto a ſeſterne ſet in a place more higher than the ſuperficies of the ſame water, then by the helpe of any one of the two frames here depicted, you may cauſe the water of the ſame ſpring or well to run thither, and higher when need ſhall require.

Right.

In the firſt of the ſaid two depicted frames you may behold two wheeles, and a moueable beame or ballance with a bucket at each end: one of the ſaid wheeles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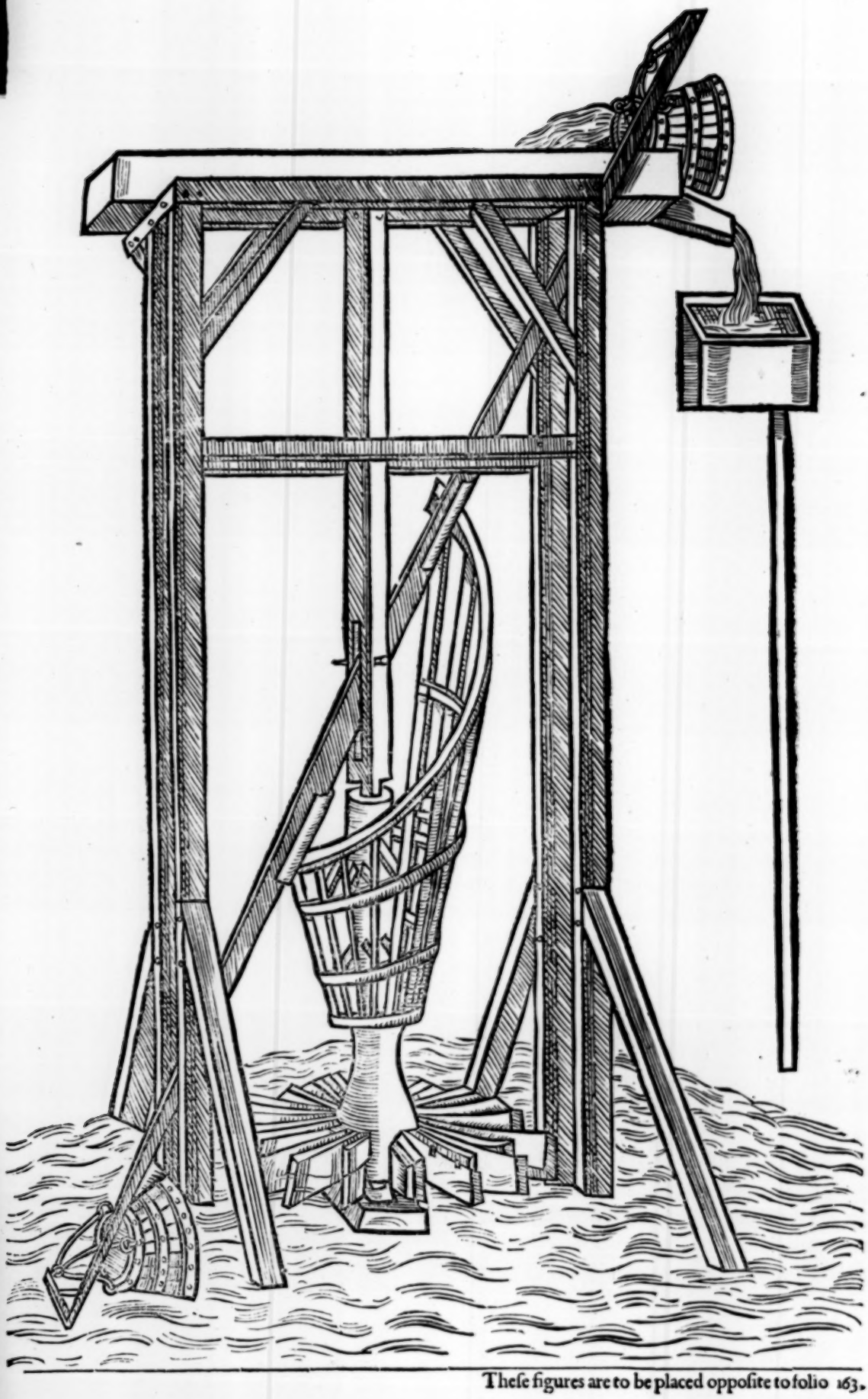


These figures are to be placed oppoſite to folio 163.

wheeles, lieth in a running riuer, and the other which may (if you will) be but ⅓ of a wheele is set close vnder the said beame or ballance: the wheele which lieth in the riuer is driuen about with the force of the streme in which it lieth, and the other wheele which is a slope wheele, and turneth about by meanes of the said water wheele, doth lift vp with his high mouing side, one of the said buckets filled with water into a trough or sesterne that receiueth the same water, and at the same instant with his low mouing side doth let downe the other bucket into the said streame or riuer, so as the bucket which is ful of water shall with the said high mouing side of the slope wheele be alwayes raised vp into the said trough or sesterne (from whence the same water may be carried in pipes to an other sesterne in another more lower place) and the emptie bucket shall continually with the low mouing side of the said slope wheele be let downe into the riuer to be filled with water.

The second of the said two depicted frames hath vnder a roofe in the toppe a wheele with sailes of linnen cloth, which turneth about with the wind whersoeuer it bloweth, and at the lowest end of the axell tree of this wheele there is another wheele garnished with diuers pinnes, (of some named cogges) like a wheele in a grist mill. This second named wheele drieth about by meanes of those pinnes a lesse wheele that carrieth vpon one end of his axeltree another small turning wheele (which for a difference may be called the fourth wheele) furnished with diuers parallel rodds full of such hackes or teeth, as are in pothangers, and sawes, set after one way in some of those rodds, & after a contrarie way in some other of those rodds, and in the water of the spring or well there is another turning wheele like in all points vnto the said fourth wheele, about which two like wheeles hangeth a strong chaine fast linked togither at both ends, and vnto this chaine, diuers dishes, boles, or buckets ioyned togither in their bottomes are tied, so as howsoeuer the said chaine goeth about the said two like wheeles, some of the said dishes, boles, or buckets, that is to say, the dishes, boles, or buckets which haue their hollow mouthes vpwards, shall alwayes carrie vp water to a trough which must lie a little vnder the said fourth wheele, and so from thence the same water will runne in pipes vnto any sesterne or other place lying vnder the leuell of the said trough, and by the helpe of this frame you may also draw water out of any cole pit, mote, or dich, or any other hole, and bring water vnto any high peece of ground whatsoeuer.

CHAP. X.

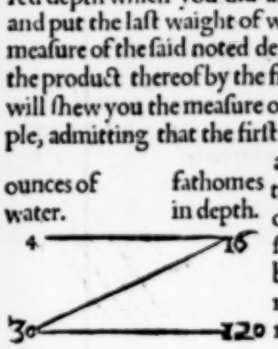
How you by knowing the depth of a sea in any one part of it, may learne the depth of the same sea in any other part thereof.

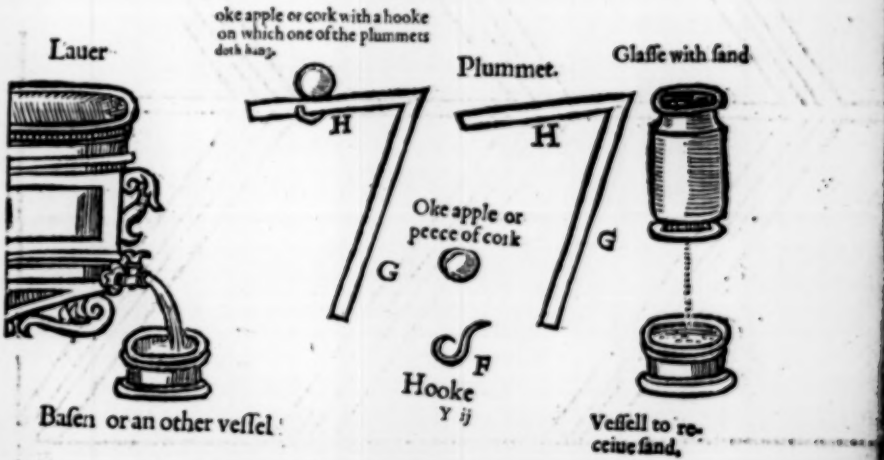
PRepare in a readinesse a lauer to hold water, and a faire cleene basen to receiue the water which shall runne out thorow the cocke of the lauer: or in

ſteed of a lauer, you may prepare a glaſſe of a conuenient bigneſſe with a little hole in the bottome, ſo as fine drie ſand (with which the ſaid glaſſe muſt be filled) may at any appointed time without ſtoppe paſſe thorow it into a veſſell that of purpoſe muſt be placed vnder the ſaid hole to receiue the ſame ſand: and withall you muſt haue a ſtopple to cloſe vp the ſaid hole ſo often as neede ſhall require. Alſo you muſt prouide an oke apple, or a peece of corke, vnto which an Iron hooke faſhioned like vnto the figure of fiue marked in the tipe following with F, muſt be faſtened. Moreouer cauſe diuerſe plummets to be made of ſuch equall waight as one of them hanged vpon the ſame hooke may both weigh it and the oke apple or peece of corke vnto which it is faſtened downe to the bottome of any ſea. The faſhion of euerie one of the ſame plummets muſt be like to the tipe marked here with G. Then to know the depth of the ſea in a part thereof, fill the ſaid lauer with water, or the ſaid glaſſe with drie and fine ſand, and hang one of the ſaid plummets (in that part which is in the ſaid tipe marked with H) vpon the ſaid hooke. This done put the ſaid plummet hanging ſo vpon the hooke into the ſea, and at that verie inſtant time when the ſaid oke apple or corke beginneth to ſinke thorow the waight of the plummet, let water runne out from the lauer into the prepared baſen, or let ſand run out from the ſaid glaſſe into a veſſel, which as I ſaid before muſt be ſet vnder it: and inſomuch as the ſaid plummet ſo ſoone as it toucheth the bottome of the ſea will by reaſon of his ſaid faſhion ſlide off from the ſaid hooke, and fall along vpon the ground, and that the ſaid hooke and oke apple or cork being ſeparated from the plummet wil riſe vp againe to the top of the ſea water, it behoueth you to watch diligently their riſing vp, and preſently vpon their comming vp to the toppe of the ſea water, to ſtop the water running out of the lauer, or (if you ſhall vſe the glaſſe with ſand) to ſtoppe the running of the ſand out of the glaſſe: which done, weigh iuſtly all the water that hath ſo runne out of the lauer into the baſen, or (if you haue in ſteede of water vſed ſand) weigh iuſtly the ſand that did run out of the glaſſe into the prepared veſſel, while the hooke and oke apple or corke were vnder the water, and afterwards meaſure exactly with a cord tied to a poize of lead the depth of the ſea in that place where your plummet, hooke, and oke apple or corke did ſinke, and write in your memoriall the ſaid meaſured depth, and alſo the ſaid waight of water or ſand. When all this is done, if you will meaſure an vnknowne depth in any other part of the ſea, hang another of the ſaid plummets of equall waight vpon the ſaid iron hooke, and putting them into the ſea in that place where the vnknowne deſired depth is, let the ſinke downe to the bottome thereof, and at that inſtant time when the ſaid plummet, hooke, and oke apple, or corke beginneth to ſinke, turne the cocke of the lauer, ſo as the verie ſame water which ranne from it before into the baſen may now againe after the ſame manner iſſue out into the ſaid prepared veſſell: or if you ſhall vſe ſand in ſteed of water, let it at that inſtant beginne to run out of the glaſſe into

Note.

into the prepared veſſell, as it did before when you did meaſure the depth noted in your memoriall, til you ſhal ſee that the ſaid oke apple or corke is come vp from the bottome of the vnknowne and deſired depth to the toppe of the ſea water, which you muſt carefully expect, that the running of the water and ſand may then be ſtopped: for neither the ſaid water nor ſand muſt be ſuffered to runne into the prepared veſſell after the ſaid oke apple or corke ſhall appeare vpon the top of the water. All this being done weigh aduiſedly all the water or ſand which is in the ſaid prepared veſſel (which waight for a differēce ſhall here be called the laſt waight) and then to find this vnknowne and deſired depth, worke thus by the golden rule: put the waight of water or ſand which you did firſt write in your memoriall, in the firſt place, put the meaſured depth which you did alſo write in your memoriall in the ſecond place, and put the laſt waight of water or ſand in the third place, then multiplie the meaſure of the ſaid noted depth in the laſt waight of water or ſand, and diuide the product thereof by the firſt waight of water or ſand, and ſo the quotient will ſhew you the meaſure of the vnknowne and deſired depth. As for example, admitting that the firſt noted waight of water or ſand was foure ounces, and that the meaſured and noted depth was fixteene fathomes, and that the laſt waight of water or ſand was thirtie ounces, multiplie 16 in 30, and ſo the product thereof will be 480, which diuided by 4, yeeldeth in the quotient 120 fathomes for the meaſure of the deſired depth. And after this manner you may find the depth of water in any riuer or well whatſoeuer.





CHAP. XI.

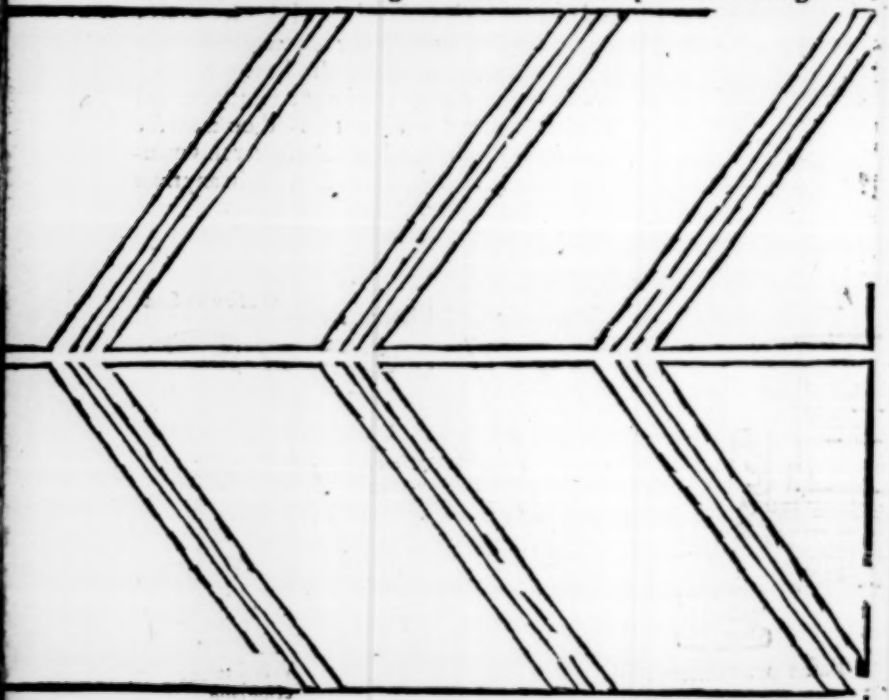
How you may breake the force of running waters which weare away land.

MAke a pale of piles and hurdels well wrought at the pitch of the water, tie vnto the ſaid piles and hurdels ſome certaine number of buſhes at ſuch length as they may riſe and fall with the water, and by ſo doing you ſhall gather a whirlepoole within the compaſſe of the ſaid pale, which in a ſhort time will fill vp, and cauſing the water to pitch on the other ſide, weare away the ſhelfe that did driue the water vpon your ground.

CHAP. XII.

How you may draine wet grounds and bogges, and how you may learne by the foure bookes of Lucar ſolace to inuent new works, ſtrange engines, and inſtruments not onely for priuate pleaſure, but alſo for ſundry purpoſes in the common wealth.

DIgge a narrow and ſtraight ditch of one foote in deepeneſſe, and halfe a foote in bredth through the moſt conuenient place of the wet ground,



and

& digge from your ſtraight ditch (at the fartheſt) two pearches a ſunder, ſlope gutters or drainers as this figure ſheweth. Digge them one foot & ½ foot deep, one foote brode in the bottome, and not aboue a quarter of a foot brode at the top. Fill the ſaid dich, and alſo the ſaid gutters or drainers all along vp to their tops with ſtones: & to the end you may looſe no ground, couer the ſaid ſtones all ouer with turfe laid plaine with the ground by euerie ſide of the ſaid ditch and drainers. But to draine a bogge you muſt in the firme ground within ten foot at the fardeſt from the bogge make a narrow ditch from the higheſt part along by the bogges ſide as the current lieth, and continue your dich vntill it come vnto ſome deepe pit without your ground that may receaue all the water in the bogge: and after you haue made this ditch one foote deeper than the ſpring which feedeth the bogge, fill it all along halfe ful with ſtones, & throwing in earth vpon the ſame ſtones, couer the top thereof with turfe, and by ſo doing you ſhall looſe no ground, and the water which was the cauſe of the bogge will alter his courſe, and runne thorow the ſaid dich among the ſtones into the ſaid deepe pit, whereby the bogge in time will ſinke, proue firme, and be good ground.

I might enlarge this fourth booke with many other profitable deuiſes, but for want of good health I muſt leaue to do ſo til another time, & here at the abrupt end therof declare briefly vnto each vnpartial reader, that he may learne by my foure bookes of *Lucarſolace* to inuent new workes, ſtrange engines and inſtruments, not only for priuate pleaſure, but alſo for ſundrie purpoſes in the common wealth, & if he be an artificer, to the better maintenance of his eſtate.

The ende of the fourth booke of LVCARSOLACE.

Dedit Deus hijs quoque finem.

Laus Deo omnipotenti.

Non baſti all' huomo di ſapere, ſe tutto quello ch'egli ſa, non mette in proua & inoperatione.

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